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SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS

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Illumination Control for a Direction-Indicating System for the M-45 Tracking Camera Mount

By SAMUEL E. DORSEY

A powered tracking mount for rocket and guided missile photography has been developed at the U.S. Naval Ordnance Test Station, China Lake, Calif., as previously described in this Journal.[1] This mount, designated as the M-45 "Gooney-Bird," has now been further improved through the addition of direction- indicating equipment. The design and development of an electronic illumination control for this direction-indicating and recording system are described in this article.

THE PRINCIPAL parts of the direction-indicating system for the M-45 tracking camera are shown in block form in Fig. 1. The Mitchell chronograph camera in the M-45 has a small side lens and mirror combination which is used to photograph a secondary image in one corner of the film frame simultaneously with the recording of the main image. This side lens was originally used to photograph the dial of a stopwatch to give the time the image was taken, but the stopwatch method was not as accurate as desired and did not lend itself to synchronization with other instrumentation. Timing information is now provided by the recording of binary coded timing markers along one side of the film.

Figure 2 is an artist's drawing of a frame of film shot by the Mitchell chronograph camera in the improved M-45. The side lens image of the direction-indicator dials can be seen in one corner of each frame. The binary coded timing markers are not included in this sketch.

Two synchro generators are situated in the angular-positioning gears of the M-45 — one to gather information of azimuth; and the other, information on elevation. The gears are such that the shafts of the generators rotate 36 times as fast as the camera mount, or one revolution for each 10 degrees of rotation of the mount. This information is transmitted to two synchro motors mounted within an enclosure attached to the side lens of the Mitchell chronograph camera. Each synchro motor has two dials, one of which it drives directly and the other, much more slowly, by gears. These four dials can be photographed; however, if the dials were constantly illuminated while the camera mount rotated, there would be enough movement of the dials when the shutter was open to smear the readings and make them useless. To eliminate this smear, the dials are illuminated by flash lamps. These lamps operate through the flashlamp control unit by means of the shutter-controlled contacts within the Mitchell chronograph camera.

A contribution received on October 16, 1956, from Samuel E. Dorsey, Research Dept., U.S. Naval Ordnance Test Station, China Lake, Calif.

[1] Myron A. Bondelid, "The M-45 Tracking Mount," *Jour. SMPTE, 61:* 175–182, Aug. 1953.

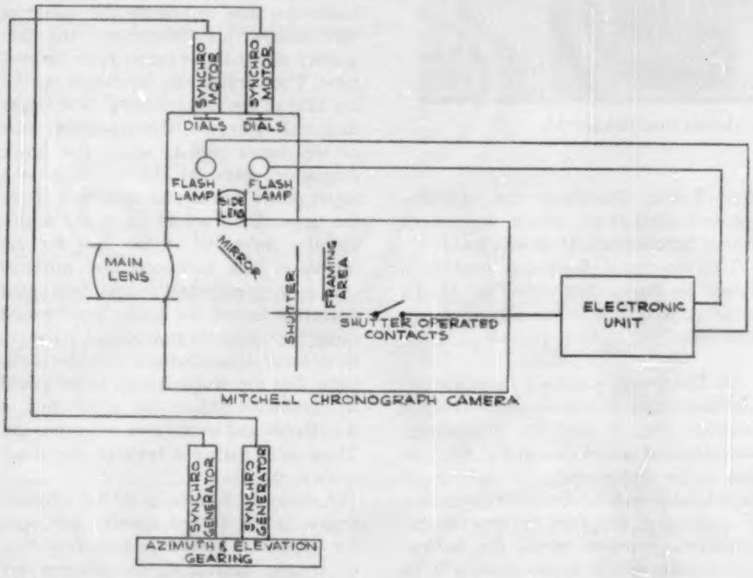

Fig. 1. System block diagram.

Fig. 2. Film sample.

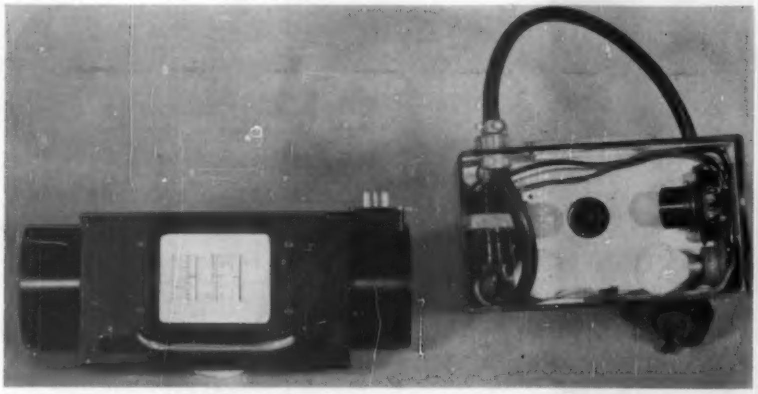

Fig. 3. Synchro motor-driven dials.

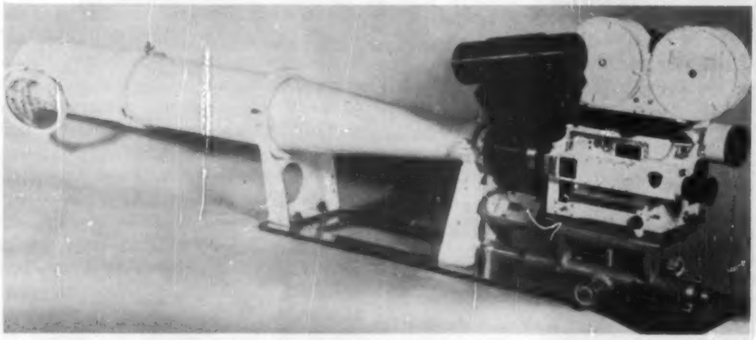

Fig. 4. Camera with dial box in place.

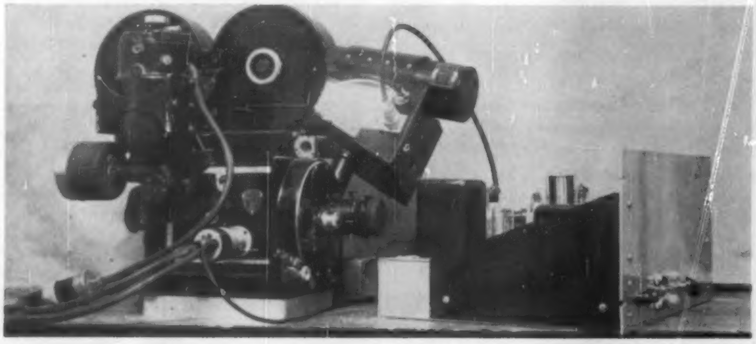

Fig. 5. Camera, dial box, and flashlamp control chassis interconnected.

Figure 3 illustrates the synchro motor-driven dials. In Fig. 4, the camera is mounted with its side lens dial box attachment in place. Figure 5 shows the camera, dial box, and the flashlamp control chassis interconnected (the entire system with which this article is concerned except for the synchro generators). Figure 6 shows the improved M-45 in operation on one of the ranges at the U.S. Naval Ordnance Test Station, China Lake.

The Electronic System

The shutter-operated contacts in the chronograph camera and the flashlamp control unit furnish power and synchronization to the flash lamps so that their flashes illuminate the synchro-operated dials at the instant the camera shutter is wide open to the side lens.

The electronic flashlamp control is shown in block diagram (Fig. 7). In order to flash the lamps properly, two difficulties had to be overcome:

(*1*) The system was made more insensitive to chatter, as follows (refer to block diagram, Fig. 7, and the exaggerated and idealized waveforms in Fig. 8): As long as the shutter-operated contacts are closed, the input (a) from the contacts is grounded and, therefore, has zero voltage. When the contacts open, the voltage very quickly rises to approximately 100 v through the resistor R1. Thus the waveform of voltage in Fig. 8(a) has an almost instantaneous rise at the moment the contacts break clean, and a chatter appears at the time the contacts are closed. The output (b) of the first RC differentiator is fed into the signal input of the gating amplifier-inverter. The output (c) of this amplifier is fed back through a loop, consisting of a one-shot multivibrator and an RC delay circuit, into the control input of the gating amplifier. As it is a single-stage amplifier, it also inverts the signal it passes. Thus, a positive pulse obtained at (b) through differentiation of the wave front at (a) appears as a negative pulse at (c).

When the one-shot multivibrator receives a negative pulse at the input, it injects into its output another negative pulse much longer than the input pulse. The one-shot multivibrator allows the first pulse of a camera-shutter cycle to pass through the gating amplifier to (c), but closes the gate and holds it closed at the time the chatter, which contains positive pulses due to differentiation, appears at the signal input of the gate.

The RC delay slows the action of the gate control by the one-shot multivibrator so that it does not take effect until the first pulse passes. The length of the pulse out of the one-shot multivibrator must be greater than that shown in Fig. 8 (e-1), long enough to blot out the chatter but not so long that it interferes with the passage of the first pulse of the next camera-shutter cycle. In fact, the multivibrator must be ready to trip again at the onset of each succeeding shutter cycle. This maximum pulse length (6 or 10 msec — depending on the speed of the camera) is shown approximately in Fig. 8 (e-2).

The exact delay time to incorporate into the multivibrator was determined by the use of the graph in Fig. 9. Its horizontal axis represents the speed of the camera and, therefore, the frequency of the input pulses from its contacts. The vertical axis represents the delay time of the multivibrator. The upper diagonal represents the repetition time of the input signal, while the lower diagonal represents the width of the input pulse. Attempted operation above the upper limit would cause the multivibrator pulses to be too long for the repetition rate indicated and interfere with subsequent input pulses. Attempted operation below the lower limit would cause the multivibrator output pulses to be so short in comparison with the input pulse that the multivibrator pulse would be completed before the occurrence of the chatter and would give no protection. Thus, only the area between the diagonals is effective.

A delay of 8 msec is in the effective region for all desired speeds; but since the upper and lower limits are very close to erratic operation, two ranges are used. A switch on the front of the chassis

chooses either 6 or 10 msec by changing capacitor values in the multivibrator circuit. These two positions (6 or 10 msec) are labeled "over 70 fps" and "under 30 fps" (flashes per second) and are used when the camera speeds are at these rates. When the camera speed is between these two extreme values, either switch position may be used.

(*2*) To overcome the difficulty of requiring 120 flashes/sec (the maximum speed required of the camera being 120 frames/sec) of lamps rated only 100 flashes/sec, two lamps were used and they were flashed alternately (see Figs. 7 and 10).

To accomplish this, the negative output pulses of the gate (c) are fed into a binary flip-flop. Both output circuits of the flip-flop are employed, each feeding an RC differentiator with square waves oppositely phased and of half the frequency of the gate output, Fig. 10 (c), (f) and (g). The pulses resulting from this differentiation of the output of the flip-flop, shown in Fig. 10 (h) and (i), are fed into cathode followers which act as buffers. The grid of each cathode follower is rather heavily biased so that the outputs contain only the positive parts of (h) and (i). These are shown in (j) and (k) of Fig. 10 as positive pulses at half the frequency of the camera cycle and are 180° out of phase with each other. Each buffer drives a thyratron, its output pulse causing the thyratron to discharge a capacitor into the primary of a spark coil. The discharge into the spark coil causes its secondary to trigger the flashing of the proper flashlamp, as shown in Fig. 10 (l) and (m). The flashlamp, upon being triggered, causes its flash capacitor to discharge suddenly through the lamp and produce a flash of light. The thyratrons and the flashlamps are self-extinguishing and so are ready for succeeding cycles.

The circuit diagram of the electronic flash-control unit is given in Fig. 11. The Power Supply and Plug-In Units are shown in Figs. 12 and 13.

Fig. 6. M-45 tracking camera mount.

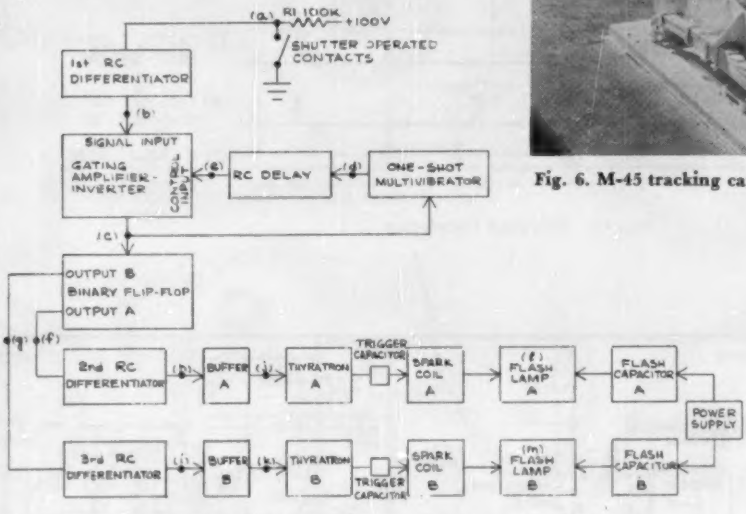

Fig. 7. Block diagram of flashlamp control.

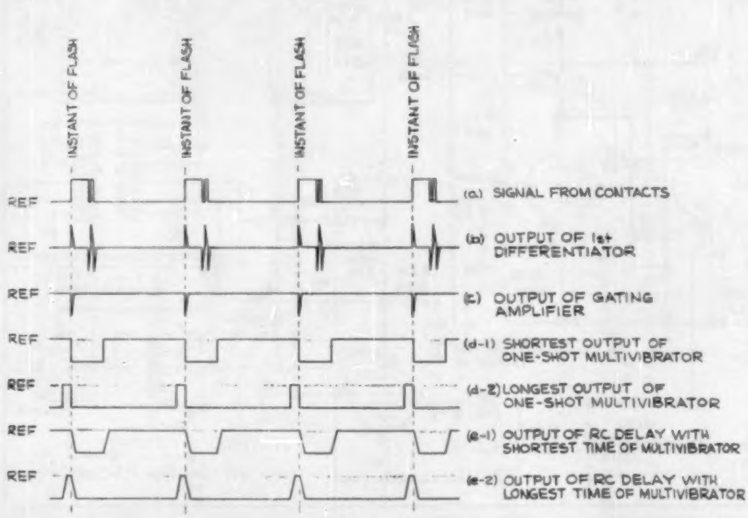

Fig. 8. Idealized waveforms.

Conclusion

Position data from the M-45 opens up a whole new field of use for the mount. Because of its mobility, the M-45 can service any range and make position data available to it.

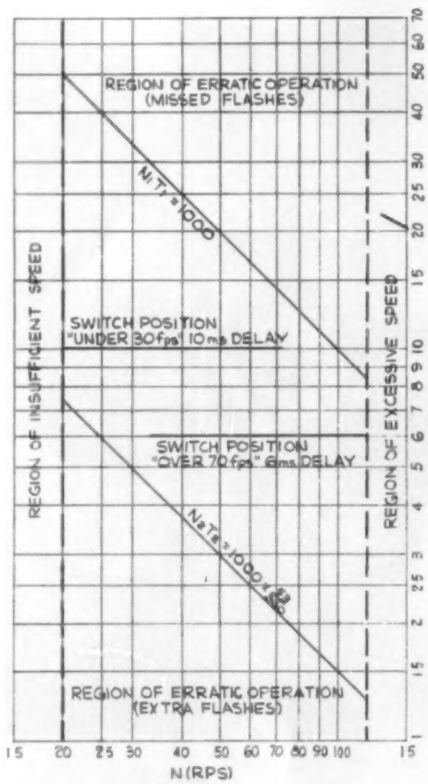

Fig. 9. Choice of multivibrator time.

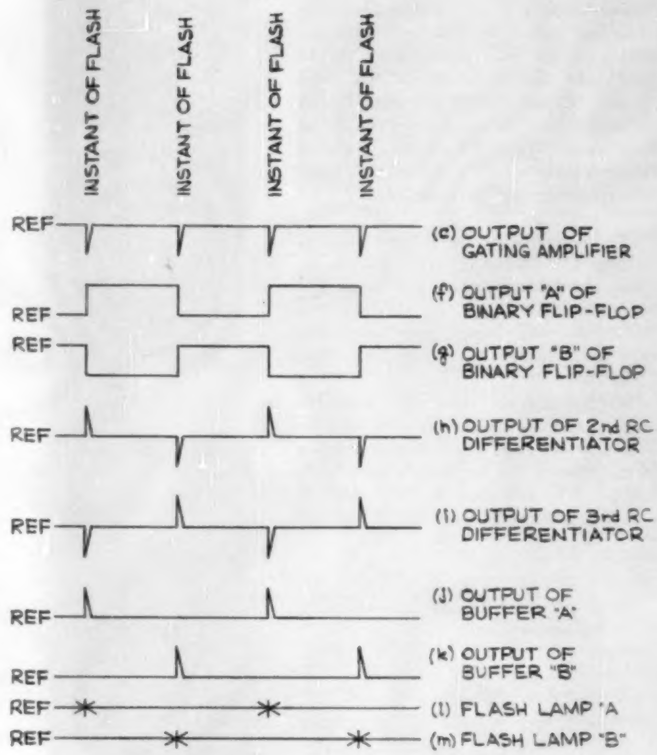

Fig. 10. Idealized waveforms.

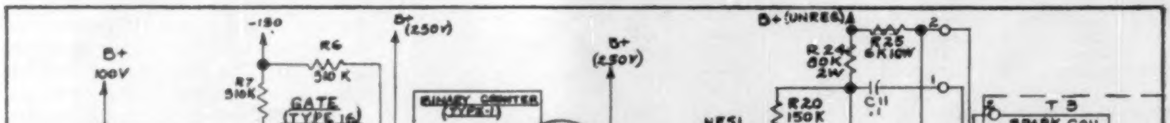

Fig. 11. Circuit diagram of electronic flash control unit.

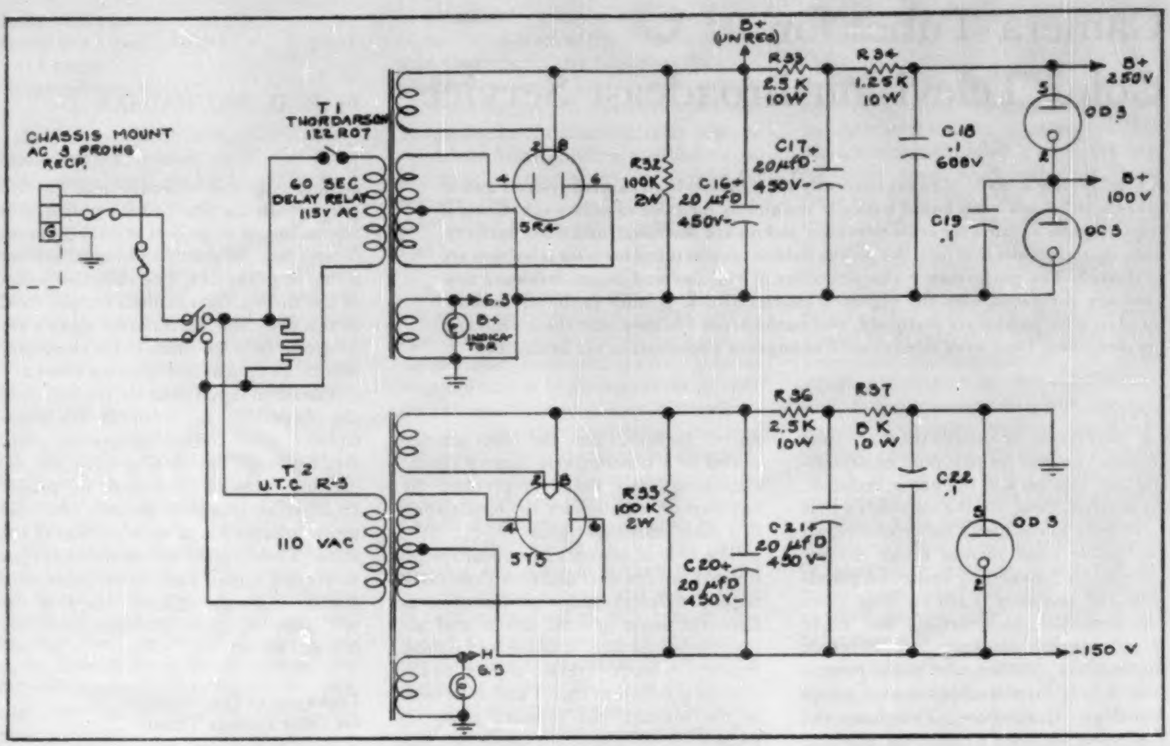

Fig. 12. Power supply for electronic flash control unit.

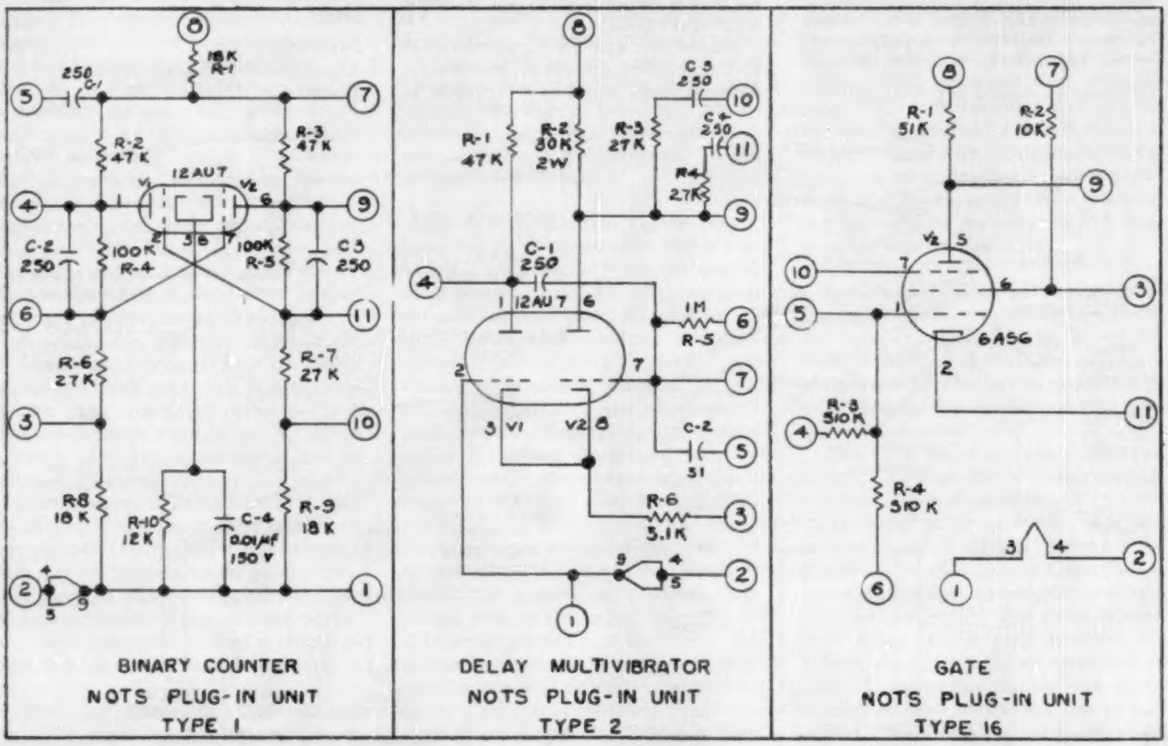

Fig. 13. Plug-in units used in electronic flash control.

Camera Tubes for Color Television Broadcast Service

By R. G. NEUHAUSER

A brief review is made of tubes currently used in television camera systems and of tubes which have been found basically unsuitable for color camera work. General requirements of tubes for color television pickup are discussed, and basic performance characteristics that limit the pickup field to several tubes for color television are evaluated. The performance characteristics of vidicons and image orthicons now used are compared with the required characteristics. Quality problems encountered in color pickup are discussed, and methods used to overcome these problems are described. Operating devices used to improve performance are evaluated.

Two different camera tubes are used in color cameras for television broadcasting: the vidicon and the image orthicon. At present, these are the only tubes that have been found useful for producing an acceptable color picture under the requirements imposed by broadcast standards and practices. Each of these tubes has desirable characteristics that make it suitable for particular conditions or applications. Neither tube at the present time is fully capable of being used for all broadcast applications. Therefore, the two tubes are used in different manners and for different service. The image orthicon is used in cameras for both studio and outdoor live pickup. The vidicon is used in film and slide pickup service or in live scenes for which high light-levels can be conveniently produced. In both cases, the tubes are operated in a simultaneous camera system employing three tubes to produce the required information for the formulation of a color television signal.

Presented on October 8, 1956, at the Society's Convention at Los Angeles by R. G. Neuhauser, Tube Div., Radio Corp. of America, Lancaster, Pa.
(This paper was received on October 17, 1956.)

The type of layout and optical system utilized for the two different cameras is slightly different, although the cameras have the same general layout and arrangements for light splitting and optical registry. A block diagram of each of the systems is shown in Figs. 1 and 2. In both of the systems, the primary image is focused on the plane of a condenser lens and relayed to the tube face upon which the proper color image is formed. This system is utilized to provide a suitable working distance between the lens of the camera or film projector and the tube faces for the light-splitting elements of the optical system. Each system is unique in its application.

Because live camera requirements are such that different lenses are required for different angle shots, it is desirable to change only one objective lens for this purpose. In the film camera system, it is advantageous to project several different images into the system in succession from different projectors. The objective lenses of the three color channels remain fixed in this case, and the different images are projected onto the plane of the condenser lens by an optical multiplexing system.

The video signals that are derived from the three camera tubes of the color camera, when optical images are properly registered on the tube faces and the camera tubes are scanned in proper registration, represent the red, blue and green information of each portion of the scene. These signals are used to form the final color signal. Each video signal represents a sharply defined image of the red, blue or green information of the original scene.

Performance Specifications for Color Camera Tubes

Numerous specifications might be devised for performance and electrical characteristics of camera tubes for both simultaneous and sequential color television cameras. The most important characteristics determining directly the accuracy of reproduction of a color scene are:

Sensitivity
Light-Transfer Characteristics
Black-Level Reproduction

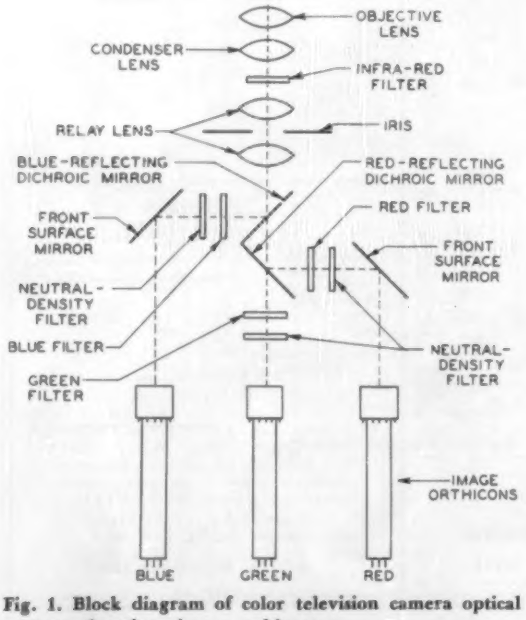

Fig. 1. Block diagram of color television camera optical system using three image orthicons.

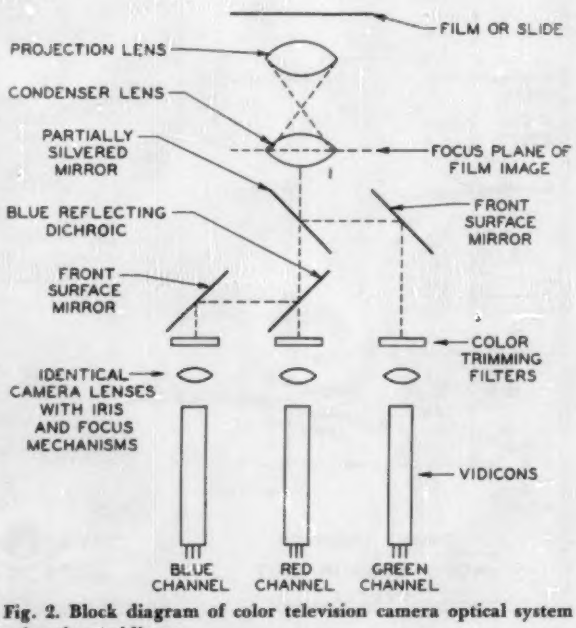

Fig. 2. Block diagram of color television camera optical system using three vidicons.

Spectral Response
Resolution and Ability to Register Images
Signal-to-Noise Ratio

A review of each one of the above characteristics follows to illustrate its importance and significance in color television camera use.

Sensitivity: The photosensitivity of the tube for direct studio pickup should be very high because of light loss and absorption in the optical and color trimming system. The lens system should pick up and transfer to the camera tubes enough light to properly expose the three tubes. Studio lighting requirements become almost prohibitive if more than 500 ft-c are required. Depth of focus should be equivalent to that provided on double-frame 35mm film with an aperture of not less than $f/6.3$.

Film pickup requirements are less stringent, since it is easy to obtain average illumination levels of 0.5 to 1.0 lumen on the photosensitive surface of the camera tube from the film projector. Sensitivity is no problem for a camera tube for this application, provided the tube can store the information during film pulldown time.

Light-Transfer Characteristics: A camera tube for color pickup should have a predictable and constant light input vs. signal output that is the exact complement of the grid-drive vs. light-output characteristic of the reproducing kinescope. The desired characteristic is a signal output that varies approximately as the 1/2.5 power of the incident illumination or, in television tube terminology, a constant "gamma" of 0.4. By the use of appropriate gamma-correction circuits in the video amplifier, a video signal having practically any transfer characteristic can be modified to produce a signal having the desired signal gradient. It is preferable, but not a requisite, that this characteristic follow a simple power law for the values of illumination to simplify the gamma-correction circuits.

A *predictable* gamma characteristic is desired so that each portion of the video signal developed has an exact relationship to the light energy of the scene that reaches the corresponding portion of the camera tube. The signal should not be affected by overall illumination level or adjacent area illumination or other modifying influences. If these conditions are not met, colors of different luminosity will not be reproduced in proper hue, and portions of a scene will have their hue or saturation change as a function of the overall illumination level or illumination of adjacent portions of the scene.

Black-Level Reproduction: This characteristic is usually considered as a separate one for a camera tube. If the requirement of predictable gamma is achieved, accurate black-level will automatically result. Conversely, any tube that does not produce a signal having substantially accurate black-level information will not be suitable for simultaneous color camera operation. Small values of spurious signal developed during scan can usually be compensated by "shading" insertion if they do not change with scene illumination.

Spectral Response: Contrary to what might at first be assumed, exact duplication of a particular spectral response is not necessary from tube to tube. Spectral response curves of photosensitive devices do not usually show abrupt discontinuities. A reasonable photosensitivity over the entire visible spectrum is, therefore, the only special requirement because the shape of the spectral "taking" characteristic of each color channel can be and is controlled primarily by the light-splitting and color filter portions of the camera optical system, and the amount of light transferred to each tube is controlled to compensate for its response in the particular color channel in which it is operating. Indeed, each tube in the system need only have photoresponse to the light in its particular colorbands. For practical purposes, however, it is desirable that one type of tube be usable in any of the three color channels. The relative response to each portion of the spectrum is rather unimportant, since balance can be easily achieved by gain control or by individual color optical-channel light control by means of neutral-density-filter changes or changes in effective sensitivity of the camera tubes. These controls are needed to compensate for the differences in the overall photosensitivities of camera tubes that are a normal result of the processing of the photosensitive surface.

Resolution and Ability to Register Images: Resolving requirements of a camera tube for color operation are much the same as those of a black-and-white system. It is desirable to have good response to all detail information that can be transmitted within the video channel. A second factor not directly related to the tube resolving capabilities, but affecting the resolution of the final color picture, is the ability to register images in both the optical and the time-position sense that is imposed by the television scanning process. Tube geometry, optical image similarity, and deflection methods and equipment should be precise enough to enable the camera to produce three images that are well registered.

Inherent geometric distortions of any of these processes or parts (optical, tube performance, and deflection components and system) are of themselves not important, but variations in any one of these factors from channel to channel can produce misregistration and a resulting loss of resolution.

Signal-to-Noise Ratio: High signal-to-noise ratios of the video signal developed by the camera tubes are essential. The requirements are probably more stringent for color than black-and-white, since there is some evidence that high-frequency noise beating against the color subcarrier produces low-frequency noise which is more objectionable visibly than high-frequency noise. Signal-to-noise ratios of the individual color channels should be at least 60 to 1 for good black-and-white reproduction of the color signal. Operations on the video signal, such as gamma correction and aperture correction, usually decrease the signal-to-noise ratios. This decrease is partially off-set by the fact that the luminance-channel signal is derived by the addition of signals from three color channels; the signals add directly while the noise adds in quadrature, resulting in a better signal-to-noise ratio of the luminance channel than is present in any of the color channels.

Specifications Applied to Available Camera Tubes

Comparison of available camera tubes with these specifications shows certain discrepancies:

High-Velocity Scanning Tubes: Camera tubes employing high-velocity scanning at present do not meet the specification given above for predictable light-transfer characteristics or proper black-level reproduction. The uncontrolled secondary electrons generated and redistributed in the high-velocity scanning process distort somewhat the tone rendition of adjacent areas and create spurious signals that are a function of illumination levels and scene content. Tubes employing high-velocity scanning are the *image iconoscope* and the *iconoscope*.

Low-Sensitivity Tubes: Tubes such as the image dissector might be considered for color television pickup except for their lack of sensitivity. Also, their inability to store information makes necessary constant illumination during picture scanning time.

The CPS Emitron or orthicon-type tube is a medium-sensitivity tube requiring four to five times the light required by the image orthicon, making it, at the present time, a marginal performer for simultaneous color pickup. Otherwise, it meets most of the other requirements of a tube for this service. The dynamic contrast range of this tube is rather restricted since it is a linear transducer of light. Consequently it has not given satisfactory performance in film pickup service due to the wide dynamic light range encountered in film.

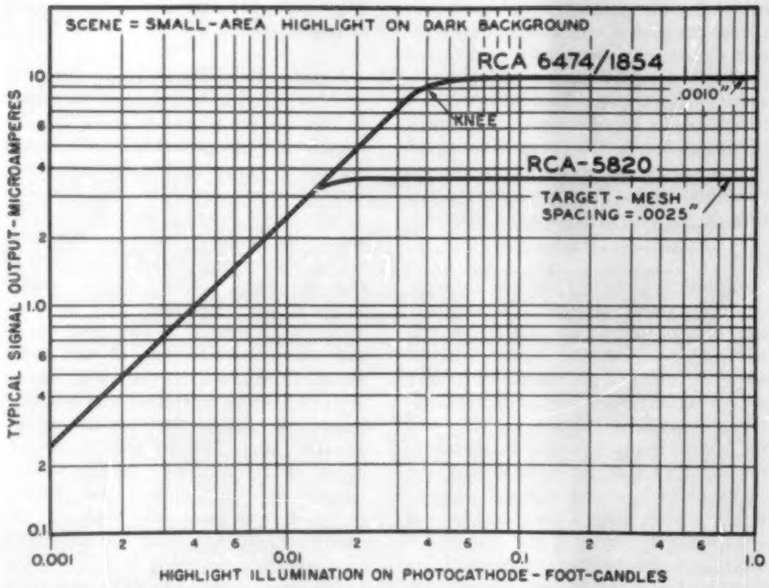

Fig. 3. Light transfer characteristics of image orthicon RCA-6474/1854 for color pickup and RCA-5820 for black-and-white pickup.

Image Orthicon as a Color Camera Tube

The image orthicon, as designed and operated for color pickup, meets all of the basic requirements for a camera tube for simultaneous color pickup, although it meets some requirements with greater ease than others. Operation under the "knee," i.e. limiting the highlights of the scene by iris or lighting control to the relatively linear initial portion of the curve of Fig. 3, produces a predictable light transfer characteristic that is essentially linear. Operation so that the highlights of the scene are over the knee portion of the curve is undesirable because, in this instance, the image section behaves in a manner similar to a tube operated with high-velocity scanning. The secondary electrons from the target are then no longer collected by the target collector mesh but are free to travel some distance from their point of origin and, upon landing, distort adjacent area charge patterns, with a resulting loss of accurate black-level at these points, or distortion of other tonal values.

For example, a human face has fairly high red light reflectivity. If the camera were operated so that the illumination of the red camera tube only was "over the knee," two things would happen. First, the facial tones would turn toward the blue-green because the output of the red tube would be limited in the facial highlights. This loss of red signal would be partially represented as electron charge redistribution to the darker surroundings. The second effect, therefore, would be to drive the adjacent low-light areas of the red scene toward black level, producing blue or blue-green shadows due to a deficiency of red signal from these areas. This effect would take place in either sequential or simultaneous color cameras, if operated in this manner. Image-orthicon tubes designed for color have a high-capacitance target-mesh assembly made possible by spacing the target and mesh 0.001 in. This close spacing extends the linear portion of the curve under the knee and thereby improves the signal-to-noise and contrast range.

The sensitivity of the image orthicon is higher than that of any competing camera tube. When properly exposed, excluding the light loss due to color filters in a color system, the image orthicon itself as used for color cameras is as sensitive as a photographic film having an ASA speed index of 500. This comparison is valid if the "shutter" speed is considered to be equal to that of the television frame rate.

The spectral response curve of the image orthicon, as shown in Fig. 4, illustrates that it has a considerable response in all portions of the visible spectrum; in fact, it has a wider response than the eye.

It might be well to bring up a significant point at this time with respect to the camera tube exposures and sensitivities. The color system is required to reproduce all portions of the scene that would be seen by the human eye, i.e., all information between approximately 4000 and 7000 A radiation; but it must reproduce it as it exists, not as it appears to the eye. Therefore, for equal energy (white card, etc.) each camera tube should produce the same signal output. An examination of the spectral sensitivity curves shows that, even if identical color-filter efficiency is assumed, equal signals would not be produced when the tubes are operated in a color camera. Therefore a balance of illumination levels of each channel of the color cameras is required to produce equal signals. (Electrical amplification could do the same, but signal-to-noise ratio of the underexposed channels would be unsatisfactory.)

In general, the red and blue channels have lower sensitivity than the green channel. When the image orthicon is used with incandescent light, the red and blue channels have about the same sensitivity, while the green channel usually receives more than enough light for the required exposure unless padded down by neutral density filters.

Black Level: The image orthicon is capable of producing a signal proportional to illumination, as illustrated in the discussion of transfer characteristics. Therefore, it is inherently capable of producing a good black-level signal during retrace that is representative of true blacks in the scene. Certain tube effects produce some deviation from true black-level, but these effects are not a function of scene illumination or camera exposure. They are termed "shading" signals caused by incomplete or improper collection of the return beam and they appear as a stationary pattern. Secondly, since the return beam is partially in focus as it strikes the first dynode, the dynode surface texture may be evident in dark areas of a scene. The larger components of this spurious signal can be compensated for by the addition of a fixed amount of shading signal to the video signals, but the dynode surface texture remains to contribute black-level error or unwanted signal.

Resolution: The resolving characteristics of the image orthicon tube have been found to be fully adequate for black-and-white broadcast television with present standards. The same degree of adequacy should apply to the image orthicon as used for color broadcast transmission. Registration errors contribute to loss of effective resolution, necessitating corrective measures, such as aperture correction of the individual color channel signals or of the luminance component of the color signal, to improve the resolving capabilities of the signal.

The number usually associated with the resolution capabilities of the image orthicon does not tell the whole story. The pictures developed by an image orthicon as operated for color and as operated for black-and-white television are sufficiently different in appearance to warrant some examination of the nature of this difference and its effect on apparent sharpness. The difference, of course, lies in "over-the-knee" operation as used in black-and-white cameras versus "under-the-knee" operation in color cameras.

The knee characteristic of an image orthicon is a result of the storage surface charging up to a potential at which fur-

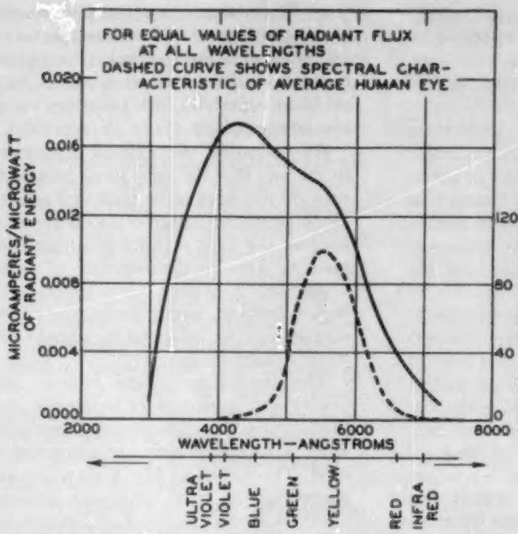

Fig. 4. Spectral sensitivity characteristic of image orthicon.

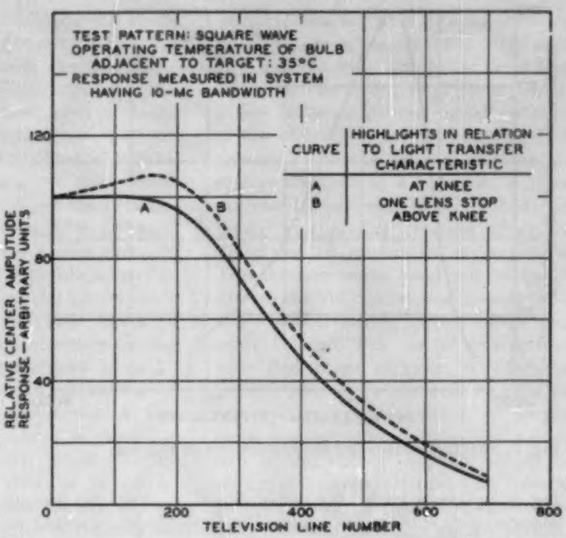

Fig. 5. Amplitude response characteristics of image orthicon.

ther voltage buildup is limited by returning secondary electrons. In this process two things happen that modify the apparent resolving capabilities of the tube.

The first is illustrated by the amplitude response curves of the image orthicon as shown on Fig. 5. Here, the curve for operation "one stop over the knee" shows an increase in detail information response above a certain point. The explanation lies in the fact that small areas, or edges of large areas, have an effectively higher capacitance per unit area than large areas have. This difference is due to the added capacitance of the differently charged adjacent areas on the target glass. (For large areas, the capacitance is essentially only parallel plate capacitance between target glass and mesh.) These small areas and edges accumulate a greater charge before being voltage limited by redistributed electrons and, therefore, produce an effectively higher signal, resulting in an apparently sharper image. This action enhances the contrast of small area signals and the outline or boundary of large area signals.

A second factor contributing to the apparently greater resolution of the image orthicon operated over the knee in black-and-white service is the redistribution to the adjacent areas of low-velocity electrons produced at a highlight. These low-velocity electrons discharge the adjacent areas causing enhanced contrast. This enhanced contrast is not unlike halation that is produced in a kinescope by internal light reflection within the faceplate, but is negative in the sense that it is a "black" halo instead of a "white" halo. In effect, the image orthicon operated in this manner is inherently capable of developing a signal that tends to cancel or compensate for the halations normally produced in a kinescope.

The *signal-to-noise ratio* of the signal produced by the close-spaced image orthicon used in color television is approximately 70 to 1 (peak signal to rms noise). When the color signals are added in the colorplexer in the proper proportions, the noise currents add in quadrature, while the signals add directly, giving an inherent improvement in signal-to-noise ratio. However, the necessary gamma correction and aperture correction of the signals both tend to decrease the signal-to-noise ratio. It is, therefore, difficult to assign a number to the signal-to-noise ratio of the color signal developed by a camera using image orthicons. The noise is below the objectionable point but has little reserve and, therefore, requires that careful attention be given to those operating factors that will maintain the best signal-to-noise ratio. These factors include the use of minimum beam current, proper multiplier focus settings, and proper amounts of aperture correction and target voltage setup.

Vidicon as a Color Camera Tube

The vidicon as a color camera tube meets all but one of the requirements for a universal color camera tube. The limitation of present vidicon tubes in comparison with the image orthicon is sensitivity. The sensitivity results in the vidicon being used primarily for film pickup work or direct pickup in areas having very high light levels and restricted speed of motion. The speed of response of the present photoconductor varies with the illumination level, mak-

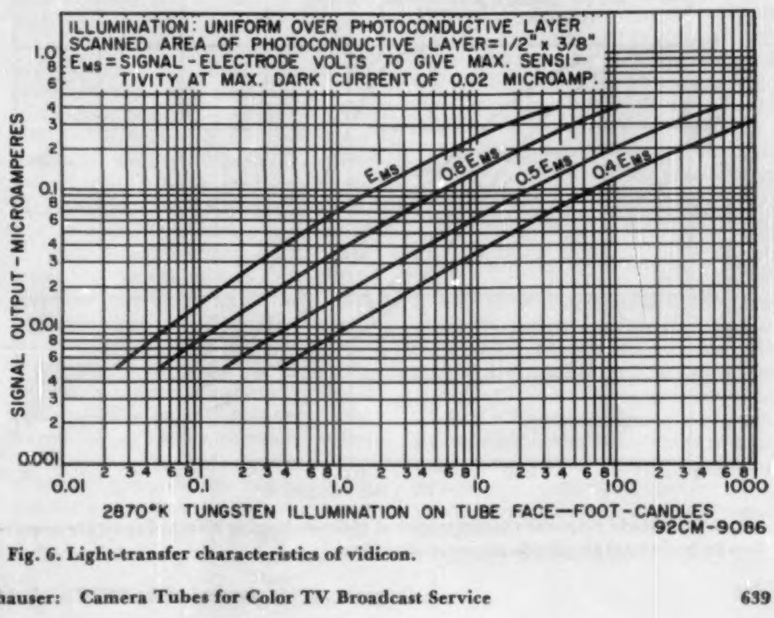

Fig. 6. Light-transfer characteristics of vidicon.

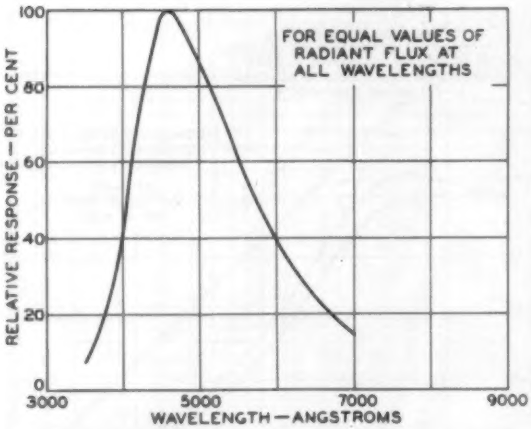

Fig. 7. Spectral sensitivity characteristics of vidicon.

ing it not very useful for conventional sequential-type of color pickup. The lag or carry-over of signal from one field to another has generally been found to produce objectionable color dilution under all but the highest light levels when used in a sequential camera in other than color broadcast applications. The sensitivity of the vidicon itself, as operated for direct pickup applications to produce desirable lag characteristics, corresponds to that of photographic film having an ASA speed index of no more than 5.

For film pickup, where light is no problem, the vidicon meets the outlined specifications for color pickup very well. The light transfer characteristics of the vidicon are the most precise of any camera tube. Besides being extremely predictable and unaffected by scene content, the transfer characteristic is nearly ideally suited to compensate for that of the reproducing kinescope. The shape of the light transfer characteristics, as shown on Fig. 6, is almost entirely dependent upon the photoconductive material properties and has proven to be constant from tube to tube. The low-velocity scanning process produces no secondary electrons that can escape to adjacent areas and cause image-charge distortion.

Black-level is also very predictable and constant. As operated for film pickup, black represents essentially zero signal current and is, therefore, constant at all parts of the tube in the absence of light. In this respect it also excells any other camera tube.

The spectral response of the vidicon (Fig. 7) illustrates its adequate response in all portions of the visible spectrum. Its response in the red regions is slightly lower than desired but has not been a problem, especially with projectors using incandescent light.

An operating convenience is present in the fact that the light levels into each tube do not have to be balanced as precisely as in the image-orthicon camera, because the light transfer characteristics have no knee or discontinuity of slope. Consequently camera setup is relatively simple because, within limits, the signal outputs can be balanced by signal electrode voltage control.

The resolution of the vidicon has proven very adequate for both color and black-and-white film pickup, especially when appropriate aperture correction is used. The curves of Fig. 8 show the response of the tube with and without aperture compensation. Full modulation in the broadcast channel in the horizontal direction is obtainable as shown, although the effective modulation is slightly less because of the single-dimension correction process used. Although its uncompensated response is somewhat lower than that of some camera tubes, it does have response at very high line numbers. Secondly, the high signal-to-noise ratio of the video signal allows corrective measures to be taken and still maintain an excellent signal-to-noise ratio.

Due to its simple construction and geometry, there is inherently little geometric distortion of the images within the tube. This feature makes registration over the entire raster very easy and precise and, therefore, maintains the good resolving capabilities of the tube.

These foregoing features permit relatively uncritical operation of the camera without departure from good color picture quality.

The signal-to-noise ratio of the vidicon can be as high as 300 to 1. Aperture correction reduces this ratio to approximately 100 to 1. Because only a small amount of additional gamma correction is needed for film having a wide contrast range, little additional noise is added in this process in comparison to gamma correction for other camera tubes or devices. The vidicon color signal is, therefore, essentially noise free even when operated with dense film stock and remains constant since light is used to compensate for different film-stock transmission.

All of these positive features concerning vidicon operation in this service lead one to assume, and rightly so, that the vidicon-type tube is the camera tube "most likely to succeed." There is a theoretical limit to the possible vidicon sensitivity which is many times that of the present tube. A small portion of this possible increase would amply satisfy all of the sensitivity needs of a camera tube

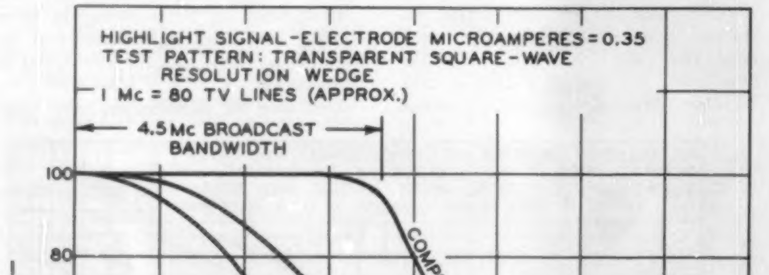

Fig. 8. Amplitude response characteristics of vidicon showing effect of aperture correction on horizontal amplitude response of vidicon.

for the forseeable future. Indeed, with such a sensitivity available, the quantum nature of light would provide the ultimate limitation on transmitted picture quality.

Difficulties in Three-Tube Systems

No system that is as complex as a three-tube color television system is free of difficulties. Some of these difficulties are rather basic; others are either quality problems or those imposed by the requirements of complex circuitry. The most obvious problem is that of registration. Ideally, the three scanning beams in the camera tubes should scan their individual scene images exactly, point by point, throughout the entire raster. Departures from this exact state show up first as loss of resolution, and finally as color fringing or multiple images of fine detail. In present cameras, registration is usually sufficiently good so that color fringing or double images of detail that are capable of being transmitted in the television band are not encountered. Some resolution in parts of the picture is lost, however, due to slight misregistrations.

Registration is achieved first by the use of precision components in the optical system, the tube deflecting and focusing assemblies, and the camera tubes themselves. The deflecting coils are driven from a common deflection power supply. Additional deflection circuitry consists of skew correction (electrical or mechanical) to provide a match between the two axes of deflection in all three of the camera tubes. Individual size, linearity, centering, and skew controls and mechanical deflecting-coil rotation provide additional flexibility of deflection control to achieve registration. The image section of the image orthicon provides a possible source of geometric distortion that is not present in a tube not having an image section, such as the vidicon, and this section must be made as precisely as possible. The geometry of the optical system can be made very accurate and is not subject to change, once properly set up and adjusted.

A second problem encountered in all such camera systems is uniformity of signal output or sensitivity over the raster. This problem is basic in the sense that no photosurface is ever perfect. It is a quality problem in the sense that it is subject to manufacturing variations. Extremely close watch is kept on all photosurface processing and much tighter specifications are held on the uniformity of sensitivity of tubes produced for color cameras. Operation devices or circuits that can be used to correct for nonuniformity of sensitivity are discussed later.

An improved photosurface having higher response in the blue and red portions of the spectrum would in itself raise the overall sensitivity of the live cameras by a factor of at least 2 to 1 because the green channel is normally padded down with neutral density filters to match the sensitivity of the red and blue channels.

Any unwanted signal added to the video signal can be considered a black-level error in the sense that it is an added signal and in the absence of light shows up as other than a true black signal and should not occur. The vidicon is excellent in this respect because in the dark essentially no current is drawn through the photosurface and true black-level is produced. There is some black-level error in the image orthicon. True black is representative of full beam return during the retrace and is reproduced as such. Errors are introduced by variations of secondary emission and collection at the first dynode surface which is partially scanned by the return beam. These errors are minor but must be kept to a minimum by proper manufacturing control and compensated for as far as possible by appropriate circuit operation.

Appropriate steps can be taken to eliminate or minimize these basic difficulties encountered in three-tube camera systems. Many improvements and modifications can and have been made on the camera tubes themselves. Improved geometric uniformity, minimizing of the amount of magnetic materials, and just plain careful workmanship have contributed much to minimizing the registration problem.

There are many operating devices or circuits that can be used to improve performance of camera tubes in simultaneous color systems. For instance, the insertion of shading signals mentioned previously is common practice for the improvement of black-level performance. Black-level uniformity cannot be overemphasized because small variations in black-level from channel to channel cause very pronounced color shifts of low light portions of a scene. Shading insertion should not be used to produce high light or sensitivity uniformity over the raster because such additional signals will distort the black-level reproduction of the individual color channels.

A circuit capable of performing the function of correcting for nonuniform sensitivity, although complex has been devised and is being used extensively with the color vidicon cameras. In effect, it is an amplifier in each color channel the gain of which is proportional to a correcting waveform of controllable shape and amplitude as normally used for shading insertion. This type of amplifier produces an extremely good match of tube sensitivities point by point over the raster counteracting most gradual uniform variations of sensitivity that correspond to readily generated waveforms.

Another operation that can be used is cathode modulation shading wherein an appropriate waveform is applied to the cathode of the camera tube. In all low-velocity camera tubes, the scanned surface is driven to the potential of the cathode, and the other element of the storage capacitor (be it the target mesh in the image orthicon or the signal electrode of the vidicon) is maintained at a fixed potential. Varying the voltage across the storage element as a function of beam position by variation of the cathode potential can produce certain effects on signal output uniformity or sensitivity. This method works very well on such a tube as the vidicon because its sensitivity is a function of the applied signal electrode voltage. The use of this method with the image orthicon is somewhat limited because it can correct only for nonuniform beam landing or target-mesh spacing; sensitivity is not a function of the voltage applied across the storage element in this tube. This method, however, must be used with caution on color systems, especially on the vidicon, because the changing of cathode potential produces some beam displacement that impairs registration and also some slight defocusing by changing the beam velocity through the tube.

Alternate Systems of Operation of Camera Tubes for Color Pickup

A highly desirable mode of operation would be one in which one camera tube would pick up information and generate the portion of the color television signal for the luminance channel. This portion would be a wide-band signal without registry problems. The other two camera tubes would generate narrow-band color signals. On casual observation, this solution might seem to be easy and desirable. The luminance or Y channel would have essentially a human-eye response, while the other two channels would have normal color camera blue and red channel response. A suitable matrix unit could subtract appropriate amounts of red and blue information from the Y channel and produce a green signal which, along with the blue and red signals, could then be used to form the other components of the color signal (Fig. 9).

An unfortunate choice (from this standpoint) is the NTSC specification for the Y channel.

This is:

$$E_Y = 0.30E_{R^\gamma} + 0.59E_{G^\gamma} + 0.11E_{B^\gamma}$$

where γ is the complementary power law correction necessary to match the kinescope light transfer characteristic. At present it is not known how any of the present camera tubes can be operated to produce a luminance signal E_Y or a signal capable of being transformed to meet these specifications without matrixing with the other color signals and introducing registry problems as a result of signal addition.

Whether a linear camera tube or non-

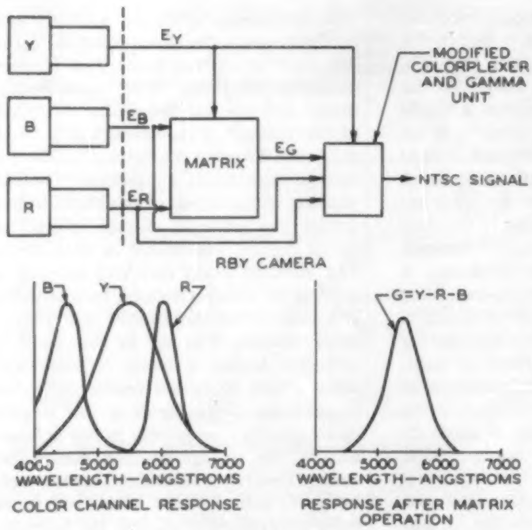

Fig. 9. Block diagram and channel response of color television system utilizing one channel for luminance (Y) portion of the color signal and the other two channels for blue and red portions.

linear tube is used, the form of the produced signal will be as follows:

For a linear device such as image orthicon:

$$E_Y = K_1E_R + K_2E_G + K_3E_B,$$

K_1, K_2 and K_3 being constants determined by the optical filters.

Gamma correction of this signal would produce a signal of the form:

$$E_Y{}^\gamma = (K_1E_R + K_2E_G + K_3E_B)^\gamma$$

which is not equal to the required form:

$$E_Y{}^\gamma = K_1E_R{}^\gamma + K_2E_G{}^\gamma + K_3E_B{}^\gamma.$$

A nonlinear device such as vidicon would produce a signal of the following form:

$$E_Y{}^\beta = (K_1E_R + K_2E_G + K_3F_B)^\beta.$$

where β is the "gamma" of the pickup tube.

This form too is not adequate and would produce errors in color reproduction. There is no presently known way of operating on this signal to form the Y or Y^γ signal as specified in the NTSC color standards.

Single-Tube Camera System

The desirability of a single tube capable of generating all of the necessary color video information is fairly obvious in that the relatively complex optical equipment, deflection circuits, and registry controls would be unnecessary. Secondly, nonuniformity of photosensitivity, etc., would not produce color shading or color shift in the reproduced picture.

At present the only approach that seems at all practical to the problem of producing the necessary signals to form a color picture from one tube is that described by P. K. Weimer, et al.,[1] at 1955 IRE Convention.

This tube, as described, is a photoconductive tube employing vertical color filter strips registered with appropriate signal output strips that are tied to the proper bus connections. It produces three simultaneous signals at three outputs. This approach uses a single scanning beam requiring no convergence or nonperpendicular beam landing incidence. Secondly, no accurate timing is required to detect color information. Accurate timing would be necessary if the tube were an image-orthicon type in which the signal information is contained in a single return beam.

The technology of making this type of tube with the precision required is extremely complex and difficult. The principles of operation and signal generation are sound and it has been demonstrated to perform the functions required satisfactorily. However, more sensitive photoconductors are required for satisfactory operation in live pickup than are available at the present time.

Acknowledgments

The success of color television camera tube performance is due in a large part to the work of R. B. Janes, B. H. Vine, F. S. Veith, F. D. Marschka, and A. A. Rotow of the RCA Lancaster Engineering Section, in developing and adapting these tubes for color camera operation.

Perhaps an even greater credit should be given the camera tube factory engineering personnel for their constant improvement of the camera tube uniformity, quality and performance. Many engineers under the direction of J. K. Johnson and H. M. Hambleton have contributed much over the years to make the manufacture and use of these complex tubes for color possible.

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Discussion

E. F. Pedersen (*RKO Teleradio, Burbank, Calif.*): You mentioned that by adjusting the signal electrode voltage you can adjust the sensitivity within limits. Could you specify these limits and also the effect this has on signal-to-noise ratio?

Mr. Neuhauser: On the vidicon tube we would like to suggest that for film operation the highlights of the image on the tube have at least 100 to 200 ft-c. You can adjust the setup so that you have less light and higher voltages applied to the signal electrode and still come out with the same signal output. This would mean that the signal-to-noise ratio is maintained the same. What you would lose would be speed of response of the camera-tube photosurface. However, if you merely increased the signal-electrode voltage and decreased the light level too drastically, necessitating gain control to bring up the signal output, you would degrade the signal-to-noise ratio of the video signal. Basically you would trade sensitivity for lag.

Mr. Pedersen: In other words, if you traded signal-electrode voltage for light, as you lower light and up signal-electrode voltage the principal effect would be one of lag?

Mr. Neuhauser: That's correct. You would eventually get to the point where you would also have poor black-level; that is, where your dark currents would become so high that you would have a poor or uneven black-level.

Switching and Controls for Color and Monochrome TV Studios

By JAMES W. THOMPSON

The approach to the problem of lighting control equipment design resolves itself into two basic areas, that of switching and that of dimming. Switching involves the ability to connect any lighting loads in the studio to any dimmer. Dimming involves the ability to modify the intensity of any of the lights in a convenient manner. This paper describes some of the equipment and methods by which this is accomplished.

The most common type of interplugging device is the retractable cord and plug type of jack panel (Fig. 1). Each lighting load terminates in a male plug. The various stage dim and non-dim control circuits terminate in female jacks (Fig. 2). It is possible to connect any light to any dimmer by inserting its plug into a jack. Since each dimmer is represented by more than one jack, it is possible to connect several lights to the same dimmer. This type of interplug panel is usually the most economical to build.

For systems of 300 loads or less it is usually possible to make panels with 100% flexibility, that is, it is possible to connect any load to any dimmer. As the number of loads in the studio increases, the size of the panel becomes larger and somewhat unwieldy, and in many cases some of the load plugs will not reach some of the jacks. It is easy for the operator to determine which dimmers are in use, and it is relatively simple to determine the loading on each dimmer.

However, the general appearance of a fully plugged panel is unsightly, and it is not easy to determine where a specific load plug is connected, as it is necessary to trace the wiring from the plug back to the identifying tag on the panel, or to search for the identifying tag on the plug handle itself in the midst of a jumble of plugs.

Presented on May 2, 1956, at the Society's Convention at New York by James W. Thompson, Century Lighting, Inc., 521 W. 43 St., New York 36.
(This paper was received on November 12, 1956.)

Cold Patching

Since the plug and the jack are subject to arcing when a plug is inserted or removed under load, various modifications have been developed to minimize or limit the effect of this arcing. One solution has been the use of a heavy-duty plug and jack which will withstand this abuse for a long period of time with only negligible deterioration.

Another approach had been to add a device to the plug and jack which will automatically open the circuit as the plug is being inserted or withdrawn. A circuit breaker may be mounted next to the jack. A skirt on the base of the plug automatically trips the breaker as the plug is withdrawn. After the plug has been reinserted, it is necessary to reset the breaker by hand.

In another system a microswitch is mounted on the jack, with an actuating cam built into the plug. This device

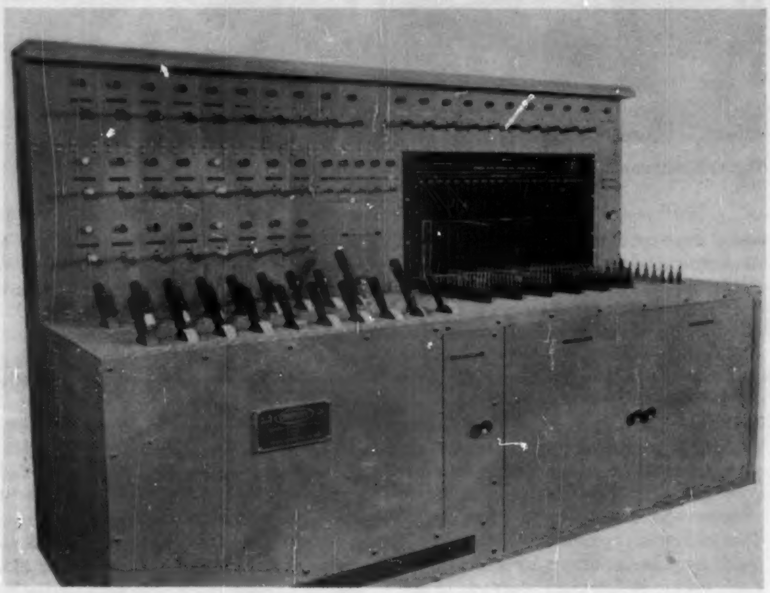

Fig. 1. Console type autotransformer dimmer board with dimmers on left and retractable cord type interplug section on right.

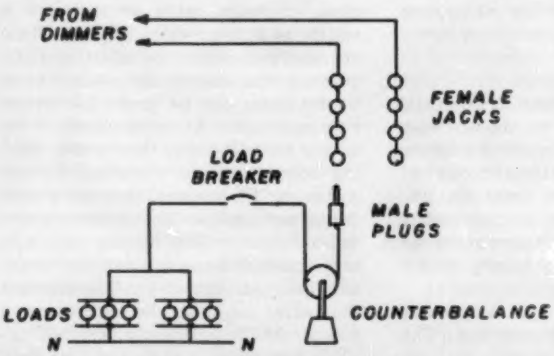

Fig. 2. Retractable cord interplug.

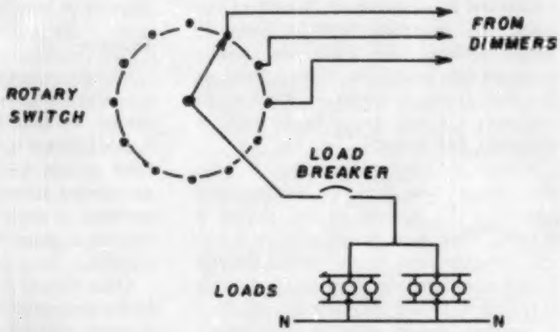

Fig. 3. Rotary switch interplug.

Fig. 4. Electronic dimmer rack with 30 5-kw dimmers.

opens the control circuits of an electronic dimmer causing the dimmer to black out, rendering the circuit open. This is usable only with electronic dimmers, and it is the only known device which eliminates the arcing.

Rotary Switches

In an effort to improve the interplug panels, several types of switching devices which do not use retractable load cords have been made. These use rotary switches with multiple positions (Fig. 3). One switch is required for each lighting load. As many positions are provided on each switch as there are dimmers in the system. The mechanics of switch design usually require a maximum of 24 positions for such heavy-duty switches. This limits flexibility because a light may be connected to only one of 24 control circuits. To overcome this problem in larger systems, the loads are usually grouped into multiples of 24; therefore, the first group connects to the first 24 dimmers, the next group to the next 24 dimmers, and so forth.

Rotary switches are also made with the cold patching device, so the circuit is automatically opened as the switch is rotated. One such switch mounts a circuit breaker next to the switch handle which automatically trips as the handle is pulled to rotate. Another design offers a mercury switch with an interlocking dog which engages the rotary handle, so that it is not possible to rotate the switch handle until the mercury switch has been open. These panels look neater and more organized than the plug-and-jack type.

Another interplugging means has borrowed the principle of the cross metering system. This uses a series of vertically mounted bus bars, one bus for each lighting load. Behind these are horizontally mounted bus bars, one for each dimmer. By inserting a jumper pin, or plug, between one of the horizontal and one of the vertical bars it is possible to connect a stage lighting load to a particular dimmer. The problems of interlocking this device to make it safe, and interlocking so that the same lighting load cannot be connected to two dimmers simultaneously are difficult to overcome; therefore, this type of device has not yet become popular in television work.

Dimming

The dimming equipment as originally supplied for television studios was very similar to that used in the legitimate theater. It was not until these systems had been in use for several years that the differences between the lighting control problem in the television studio and the theatrical stage were generally understood.

On a theater stage, the sets are located in the same general area at all times. The scenery may be changed between acts, but the same lights are focused on the same areas. In television work, several sets are usually in place at one time, and different groups of lights are used to eliminate each one. Therefore, the control function consists of sequential control of the same lights in the theater, but simultaneous control of different groups of lights in the studio.

Auto Transformers

The most common type of dimmers used in television are autotransformers (Fig. 1). These are made in 2500-w or 6000-w capacities. The dimmers are supplied with mechanical interlocking handles which make it possible to connect several dimmers simultaneously to a master handle. It is possible to dim several groups of lights simultaneously with one handle, but all dimmers so interlocked must be at the same intensity, and must all respond simultaneously and to the same degree. The lighting cues must therefore be simple in effect. Autotransformer dimmers are the most economical to build, install and maintain. They operate quietly and produce very little heat; however, their size, weight and inertia limit their usefulness in a large studio.

Motor-Driven Dimmers

In order to reduce the size of the control panel, motor-driven auto transformer dimmers are available. The dimmers are located remotely, and a small control panel is used to energize the dimmer motors. These controls consist of simple "start-stop" switches, or of more elaborate positioning controllers consisting of a potentiometer similar in appearance to a miniature dimmer handle. The potentiometer is moved to the desired intensity setting, causing a relay bridge network to energize the motor automatically until the dimmer reaches the predetermined position. There is a response time-lag from the setting of the potentiometer until the motor has driven the dimmer to the new intensity. This lag is about 6 sec from full bright to full blackout.

Electronic Dimmers

An electronic lighting-control system using thyraton tubes as dimmers is widely used in television (Fig. 4). These dimmers incorporate the advantages of a preset system whereby the intensity of all of the lights can be preset for several cues in advance. By manipulation of the master controls any of these preset lighting scenes may be energized in any sequence. Proportional mastering and fading are possible. The dimmers themselves feature infinite loading ratio and instantaneous response, and are available in capacities to 8-kw. The dimmers themselves are about the same size as a comparable auto transformer, but because they produce noise and heat, they are usually remotely located. Filters are

incorporated into the thyraton circuit to increase stability and to suppress harmonics which would otherwise affect the audio and video circuits.

Magnetic Amplifiers

The latest addition to the field of theatrical dimmers is the magnetic amplifier. This is an outgrowth of the saturable core reactor dimmer, but with improved response and increased gain. Magnetic-amplifier dimmers lend themselves to the same type of control as electronic dimmers. The dimmers are larger, heavier, and more costly than comparable thyratron types. Their speed of response is about ½ sec, and their load ratio is about 30:1. Their inherently long life and relatively heat-free operating characteristics make them compare favorably with thyratrons. New core materials and winding methods may reduce the weight and increase the response speed.

One manufacturer has announced a package unit which features a magnetic-amplifier input stage driving a saturable-core reactor stage which includes its own booster transformer. Although slightly slower in response, this combination unit combines most of the desirable features of magnetic amplifiers and thyratrons.

The Future

As television lighting systems become larger and more complex, remote control systems now in use are rapidly becoming obsolete. Reliability and flexibility are important, but it is more important to reduce the quantity and complexity of the controls. Further reduction of the individual control size is not the answer.

One approach seems to be to do some or all of the interplugging at the control end of the circuit. Thus one control would operate several dimmers. For this to be practical it is necessary to accept certain limitations of dimmer response and loading characteristics and still stay within cost limitations. The use of magnetic memory banks to take the place of the preset panel is theoretically possible, but at present, the cost of the "read-out" stage is prohibitive but it still remains a possibility.

Calculation of Candlepower and Color Temperature of Tungsten Lamps

By A. J. SANT and A. J. LETA

Over the range of greatest interest in photography, the candlepower and color temperature of tungsten lamps may be calculated with satisfactory precision by the use of simple exponential equations. Detailed examples are given which illustrate the application of these equations. The constants and exponents in these equations have been determined for several commonly used lamps. These have been arranged in a set of tables designed for convenient reference.

Calibrated tungsten lamps are widely used as light sources in the sensitometry, printing, projection and viewing of photographic films. In these applications two properties are of primary interest: (1) the luminance of the lamp, expressed in terms of "candlepower" and (2) the relative spectral energy of the radiation, specified with sufficient accuracy by stating the "color temperature" of the lamp filament.

For tungsten lamps, the use of these visual properties to characterize the radiation is thoroughly justified. An incandescent tungsten lamp filament operated at a given color temperature produces the same spectral energy, to a high degree of approximation, as a blackbody radiator at the corresponding temperature in degrees Kelvin. Thus, determination of the color temperature of a lamp provides the essential knowledge of the relative spectral energy that is produced by the lamp. Once the relative spectral energy is known, specification of the candlepower of the lamp uniquely determines the intensity of the radiation at every wavelength. The practice of specifying the physical properties of the radiation by means of its visual properties has the further advantage that relatively limited equipment is required to measure the necessary quantities. These considerations have led to fairly widespread adoption of lamp calibration methods based upon visual properties.

Considerable work has been done empirically relating the luminous output and color temperature of tungsten lamps to the input power or to voltage and current separately.

Weaver and Hussong have reviewed the empirical relationships that have been used and offer an excellent discussion and evaluation of them in "A Note on Tungsten Lamps."*

In most photographic work, lamps are seldom operated far below 2650 K because of the low luminous output that is obtained. Considerations of useful life prohibit the operation of calibrated tungsten lamps at temperatures much in excess of 3250 K. It was felt that empirical relationships that would adequately describe lamp behavior over this limited range would therefore be of practical interest.

Our experience has shown that the behavior of lamps over the range in color temperature from 2650 to 3300 K might be adequately described by relationships of the form

$$\log \frac{T_2}{T_1} = a \log \frac{(CP)_1}{(CP)_2} = b \log \frac{V_2}{V_1} = c \log \frac{I_2}{I_1}$$

where T = color temperature in degrees K
CP = candlepower
V = lamp voltage
I = lamp current.

Relationships of this form relating candlepower, voltage and current have been in common use by lamp manufacturers and other workers for many years. This type of relationship has been far less widely used for color temperature.

The purpose of the present study was to examine the "fit" that is obtained when the logarithms of the candlepower, voltage, current and color temperature are related in the manner described above over the range 2650–3300 K. The study included a number of lamps

A contribution submitted November 14, 1956, by A. J. Sant and A. J. Leta, Color Technology Div., Eastman Kodak Co., Kodak Park Works, Rochester 4, N.Y.

* K. S. Weaver and H. E. Hussong, "A note on the color temperature-candlepower characteristic of tungsten lamps," *J. Opt. Soc. Am.*, 29: 16–19, Jan. 1939.

Table I. Current as Dependent Variable.

	m	*b*	2σ
Color Temperature			
500-w, 110-v #5	1.460	−4.451	.003
500-w, 110-v #7	1.444	−4.396	$.000\bar{4}$
500-w, 110-v #8	1.442	−4.387	$.000\bar{6}$
Av. 500-w, 110-v	1.449	−4.411	.001
1000-w, 120-v	1.454	−4.210	.002
100-w, 20-v	1.447	−4.386	.003
Average	1.449	—	—
Voltage			
500-w, 110-v #5	.558	− .469	.002
500-w, 110-v #7	.558	− .470	.002
500-w, 110-v #8	.557	− .461	.002
Av. 500-w, 110-v	.558	− .466	.002
1000-w, 120-v	.558	− .229	.002
100-w, 20-v	.559	− .024	.002
Average	.558	—	—
Candlepower			
500-w, 110-v #5	.171	.121	.004
500-w, 110-v #7	.170	.124	.004
500-w, 110-v #8	.170	.126	.004
Av. 500-w, 110-v	.170	.124	.004
1000-w, 120-v	.168	.311	.003
100-w, 20-v	.167	.302	.003
Average	.169	—	—

commonly used in the sensitometry and projection of photographic films within the Color Technology Div. of the Eastman Kodak Co. The equations derived are intended to be used with limited calibration data to provide the engineer with a useful set of equations by means of which he may anticipate the behavior of a lamp over the normal range of use.

Procedure

Lamps Studied: The sample of lamps studied consisted of three 500-w, 110-v projection lamps having T-20 clear bulb and a C13 filament; one 100-w, 20-v lamp having a spherical, T-8, clear bulb and a CC2V filament; and one 1000-w, 120-v projection lamp having a T-12, clear bulb and a C13D filament.

Three of the 500-w projection lamps were studied because that type of lamp is most commonly used in the Eastman Kodak Co. in sensitometers. The 100-w lamp is less commonly used and was selected because the unusual filament design (helically coiled coil) would provide interesting data on the effects of filament design upon the results obtained. The 1000-w lamp is commonly used both in projectors and in certain types of high-intensity sensitometers. The bulb design for this lamp is radically different from that of the other types studied.

In calibrating a lamp for color temperature, the current through the lamp was adjusted until the light produced was identical in color to that produced by a standard lamp operated at the desired color temperature. The device used for matching was a Lummer-Brodhun photometer. The usual precautions were taken to eliminate the effects of differences in color due to differences in the two sides of the photometer head, geometry, etc. The accuracy of the specification of color temperature is estimated at ±0.5%. The precision of the measurements is estimated at ±0.25%.

For the determination of candlepower, the distance was found at which the lamp produced a response on a precision photoelectric foot-candle meter (of the barrier-cell type) equal to that produced by a standard lamp at a given distance. The candlepower of the lamp was then calculated from the known illumination produced by the standard lamp at the foot-candle meter and the distance from the foot-candle meter to the lamp being calibrated. The effects of drift and fatigue in the barrier cell of the foot-candle meter were carefully minimized. The estimated accuracy of the specification of candlepower is ±2%. The precision of the measurements is estimated at ±1%.

Calculations and Results

Linear relationships were derived by the method of least squares relating the logarithms of lamp candlepower, voltage and color temperature to the logarithm of lamp current.

From these basic relationships, linear equations were derived in which the logarithm of each parameter taken as dependent variable is expressed as a linear function of the logarithm of each of the remaining three parameters. Thus for each lamp 12 equations were obtained of the form $y = mx + b$. The coefficients, m and b, which apply to each relationship for each lamp in the sample are compiled in Tables I through IV.

Since three 500-w lamps were studied, there are three entries in the tables for 500-w lamps and a fourth entry which gives the average of the results for the three lamps. Also included in the tables, where current appears as dependent or independent variable, are columns denoted 2σ. These express the probable range of the deviations from the straight-line relationships owing either to systematic nonlinearity in the basic relationships or to experimental error.

Table III. Color Temperature as Dependent Variable.

	m	*b*	2σ
Voltage			
500-w, 110-v #5	.382	2.728	—
500-w, 110-v #7	.387	2.719	—
500-w, 110-v #8	.386	2.722	—
Av. 500-w, 110-v	.385	2.723	—
1000-w, 120-v	.384	2.738	—
100-w, 20-v	.386	3.015	—
Average	.385	—	—
Candlepower			
500-w, 110-v #5	.117	3.132	—
500-w, 110-v #7	.118	3.130	—
500-w, 110-v #8	.118	3.129	—
Av. 500-w, 110-v	.118	3.130	—
1000-w, 120-v	.115	3.110	—
100-w, 20-v	.116	3.240	—
Average	.117	—	—
Current			
500-w, 110-v #5	.685	3.049	.002
500-w, 110-v #7	.693	3.044	$.000\bar{2}$
500-w, 110-v #8	.693	3.042	$.000\bar{4}$
Av. 500-w, 110-v	.690	3.045	.001
1000-w, 120-v	.688	2.896	.001
100-w, 20-v	.691	3.031	.002
Average	.690	—	—

Table II. Voltage as Dependent Variable.

	m	*b*	2σ
Color Temperature			
500-w, 110-v #5	2.615	−7.134	—
500-w, 110-v #7	2.586	−7.030	—
500-w, 110-v #8	2.589	−7.048	—
Av. 500-w, 110-v	2.596	−7.070	—
1000-w, 120-v	2.605	−7.133	—
100-w, 20-v	2.590	−7.807	—
Average	2.598	—	—
Candlepower			
500-w, 110-v #5	.306	1.055	—
500-w, 110-v #7	.305	1.064	—
500-w, 110-v #8	.306	1.055	—
Av. 500-w, 110-v	.306	1.058	—
1000-w, 120-v	.301	.969	—
100-w, 20-v	.299	.583	—
Average	.303	—	—
Current			
500-w, 110-v #5	1.791	.839	.004
500-w, 110-v #7	1.791	.842	.003
500-w, 110-v #8	1.795	.828	.003
Av. 500-w, 110-v	1.792	.836	.003
1000-w, 120-v	1.792	.411	.005
100-w, 20-v	1.790	.043	.004
Average	1.792	—	—

Application of the Tables

The values of m and b given in the tables apply to linear equations relating the logarithms of the lamp parameters. These have the form

$$\log y = m \log x + b \tag{1}$$

where y is the parameter taken as dependent variable and x is the parameter taken as independent variable.

From these equations, exponential relationships can be derived. These take the form

$$y = b'x^m \tag{2}$$

where b' is the antilog of b.

To find the change in a given parameter that results when another parameter is changed slightly, differential relationships may be used. These are

Table IV. Candlepower as Dependent Variable.

	m	*b*	2σ
Voltage			
500-w, 110-v #5	3.263	− 3.444	—
500-w, 110-v #7	3.279	− 3.488	—
500-w, 110-v #8	3.267	− 3.446	—
Av. 500-w, 110-v	3.270	− 3.459	—
1000-w, 120-v	3.327	− 3.224	—
100-w, 20-v	3.342	− 1.949	—
Average	3.296	—	—
Color Temperature			
500-w, 110-v #5	8.531	−26.721	—
500-w, 110-v #7	8.479	−26.540	—
500-w, 110-v #8	8.459	−26.470	—
Av. 500-w, 110-v	8.490	−26.577	—
1000-w, 120-v	8.668	−26.959	—
100-w, 20-v	8.654	−28.037	—
Average	8.558	—	—
Current			
500-w, 110-v #5	5.844	− .705	.025
500-w, 110-v #7	5.872	− .728	.027
500-w, 110-v #8	5.866	− .741	.025
Av. 500-w, 110-v	5.861	− .725	.025
1000-w, 120-v	5.964	− 1.857	.020
100-w, 20-v	5.982	− 1.805	.020
Average	5.906	—	—

immediately derived from Eqs. (1) and (2) respectively, as

$$d\,(\log y) = md\,(\log x) \tag{3}$$

$$dy = mb'x^{m-1}dx. \tag{4}$$

Using Eq. (4), the per cent change in y corresponding to a per cent change in x is

$$100\,\frac{dy}{y} = 100\,\frac{mb'x^{m-1}dx}{b'x^m} =$$

$$100\,m\,\frac{dx}{x} = m\,100\,\frac{dx}{x} \tag{5}$$

or the per cent change in y equals m times the per cent change in x.

While Eq. (5) is very satisfactory for small changes, it should not be used where large changes in the lamp parameters are involved. For large ranges of the variables, Eq. (1) or (2) should be used.

As indicated in the illustrative examples below, the values of b are a property of each individual lamp and vary markedly even among lamps of the same type. Hence the tabulated values of b are *not* to be used in calculations involving lamps other than the ones for which they were obtained.

The range of application of the tables is defined by the limits 2650 K and 3300 K. Use of the tables beyond these limits will involve a loss in accuracy.

Illustrative Examples

Three examples are given below of typical practical problems in which the results of the present study may be used to provide the solution. The examples cited are solved in detail to show explicitly the formal mathematical procedure that is involved and to point out the physical considerations that must be taken into account.

Example 1

A printer is being designed. An ammeter will be used to control lamp current. The lamp current must be controlled sufficiently well that a precision of ± 0.005 log E is realized at the exposure plane. What must the precision of the ammeter be to realize this precision in log E?

Solution: Take candlepower (CP) as the dependent variable and current (I) as the independent variable and make use of Eq. (3) in the text. The average value of m over the entire sample is used. For this example Table IV gives the value 5.906. Equation (3) states that

$$d\,(\log CP) = md\,(\log I).$$

Using the value 5.906 for m and 0.005 as the allowable increment in log candlepower:

$$0.005 = 5.906\,d\,(\log I)$$
$$0.00085 = d\,(\log I).$$

Thus a change of 0.00085 in log current produces a change of 0.005 in log E. A change of 0.00085 in log units corresponds to 0.2%. The ammeter must provide a precision of 0.2% of the scale reading.

Example 2

A 500-w, 120-v lamp is to be used in a printer and operated at 2850 K and 3000 K. An estimate of the current (I), voltage (V), and candlepower (CP) at each of these settings is required. According to the manufacturer's specifications, the lamp burns at 3200 K when operated at its rated voltage and is rated at 1200 cp.

Solution: The average values of m taken over the entire sample may again be used. The values of b that will apply on the average for this lamp type can be obtained by using the manufacturer's specifications. According to these specifications, at 3200 K the voltage is 120, and the wattage is 500. Solving for current:

$$\frac{500}{120} = 4.17 \text{ amp.}$$

Thus at 3200 K, $V = 120$, $I = 4.17$, $CP = 1200$.

We now take current, voltage and candlepower in turn as dependent variables and use the average values of m given in the tables under Color Temperature (CT). Insert these values of m into the equations of the form:

$$\log y = m \log x + b \quad \text{that apply in each case.} \tag{1}$$

The result is:

$$\log I = 1.449 \log CT + b_1 \tag{1a}$$

$$\log V = 2.598 \log CT + b_2 \tag{1b}$$

$$\log CP = 8.558 \log CT + b_3. \tag{1c}$$

Substituting in these equations the values of V, I and CP that apply at 3200 K, and solving for b_1, b_2, and b_3, we find:

$$b_1 = -\ 4.459$$
$$b_2 = -\ 7.027$$
$$b_3 = -26.918.$$

Thus, the final relationships are:

$$\log I = 1.499 \log CT - 4.459$$
$$\log V = 2.598 \log CT - 7.027$$
$$\log CP = 8.558 \log CT - 26.918.$$

When values of 2850 and 3000 are substituted in these equations, we find:

At 2850 K $\quad V = 88.9$, $I = 3.52$, $CP = 445$

at 3000 K $\quad V = 102$, $I = 3.80$, $CP = 691.$

Example 3

A 500-w lamp is to be used in a sensitometer. Calibration of the lamp shows that the lamp draws a current of 4.0 amp and has a candlepower of 900 when operated at 3000 K. What will the current and candlepower be at 2850 K?

Solution: The procedure is analogous to that used in the previous example. The average values of m taken over the entire sample, and the basic relationship (1) are used. The values of b are found by substitution in the relationships (1) of the values provided by the lamp calibration at 3000 K. When values of b thus obtained are substituted in the relationships, we find:

$$\log I = 1.449 \log CT + (-4.436)$$
$$\log CP = 8.558 \log CT + (-26.803).$$

When 2850 is substituted for CT we find that at 2850 K:

$$I = 3.72$$
$$CP = 580.$$

Conclusion

The results of the study indicate that the value of b depends upon lamp wattage and rated voltage, as one would expect. The values of m however show very little variation among the types studied. In fact the magnitude of the variation in m among lamp types is the same as that among lamps of the same type. Thus, one may conclude that the value of m is relatively constant for a variety of filament and bulb designs. It should be noted that in the solution of the problems given as examples the average value of m over the entire sample (given at the foot of each set of tables) was invariably used.

This procedure was not employed in determining the value of b in *any* of the examples for reasons that are obvious from a study of the tables (see especially Table IV). When a representative value of b for a given lamp type is required, the value of b is estimated using the manufacturer's specifications for that type of lamp, as we have illustrated in Example 2 above. When the value of b for a particular lamp is required, the lamp must be calibrated for voltage, candlepower, and current at a single color temperature and the value of b calculated as shown in Example 3.

The overall agreement between the values of m obtained in this study and those given for gas-filled lamps in General Electric Lamp Bulletin LD-1 is good. There is enough difference however to warrant the use of the values given here for lamps of the types studied.

The method is recommended for all work except that of the highest precision. For work requiring the highest precision, it is recommended that the lamp be independently calibrated at each color temperature.

Densitometry of an Embossed Kinescope Recording Film

By W. R. J. BROWN,
C. S. COMBS and R. B. SMITH

The requirements for image analysis of Eastman Embossed Kinescope Recording Film, Type 5209, are discussed. The actual distribution of density of the embossed film image is shown. The optical requirements necessary to analyze these images are similar to those used in projection. It is further shown that these requirements can be made by a comparatively simple modification of a Westrex Densitometer. The results of sensitometric evaluation of satisfactory color images measured on this modified instrument are shown.

The use of an embossed, blue-sensitive black-and-white film for the recording of color television signals was described in an earlier paper.[1] That discussion generally concerned an ideal film and optical system. In practice, there are many optical and photographic variables which tend to compromise this ideal. For the system to be successful, these variables must be kept under control. It is the purpose of this paper to describe an instrument which will satisfactorily measure the photographic characteristics of the image. Measurements of this image can then be used to evaluate the quality of the optical components used in its recording and reproduction.

In an ideal system, the image of the red filter band or corresponding aperture, for example, would fall entirely within the area allotted to it behind each lenticule. Each image would be in the same position relative to the optical axis of its lenticule. Usually these conditions cannot be exactly met. Neither the camera objective lens nor the lenticule is perfect, and, since both are of high aperture ($f/2.3$), aberrations are present in the image. Diffusion of light between the film and the aperture also degrades the image.

After this imperfect image of the aperture enters the emulsion, light scatter within the emulsion layer tends to diffuse it somewhat farther. When this exposed image is processed, factors which would cause a spreading of the image in the processing stage may also degrade the quality of the color separation. It becomes fairly obvious that some control over the distribution of density in the color image must be maintained if the system is to operate satisfactorily.

Distribution of Density

The two photomicrographs shown in Fig. 1 illustrate the nature of the film image formed in a well-controlled optical system, when exposure is given through the red-separation aperture only or through the blue-separation aperture only. The clumps of grains are quite well confined to the proper geometric location but there are a few density-producing grains between these areas. Since exposure conditions were intended to produce density only in areas corresponding to the one aperture position indicated, density in the other areas of the emulsion was produced by the factors discussed previously.

The actual distribution of density across the film can perhaps be evaluated somewhat better by the microdensitometer traces shown below the photomicrographs in Fig. 1. The microdensitometer traces were obtained by moving the film image past a long narrow slit before making the measurements. The embossed surface of the film base was covered by a liquid of the same index of refraction as the film base. This rendered the base surface effectively flat as far as the light beam was concerned. Thus the microdensitometer optics recorded only variations in density of the silver image.

Although the desired density difference in the film, between the exposed and the unexposed areas, was meant to be as great as possible, these microdensitometer traces indicate that, in actual practice, it was restricted by the many factors which contributed to its formation. The microdensitometer trace provides a unique description of the distribution of image behind the embossings, by measuring the density differ-

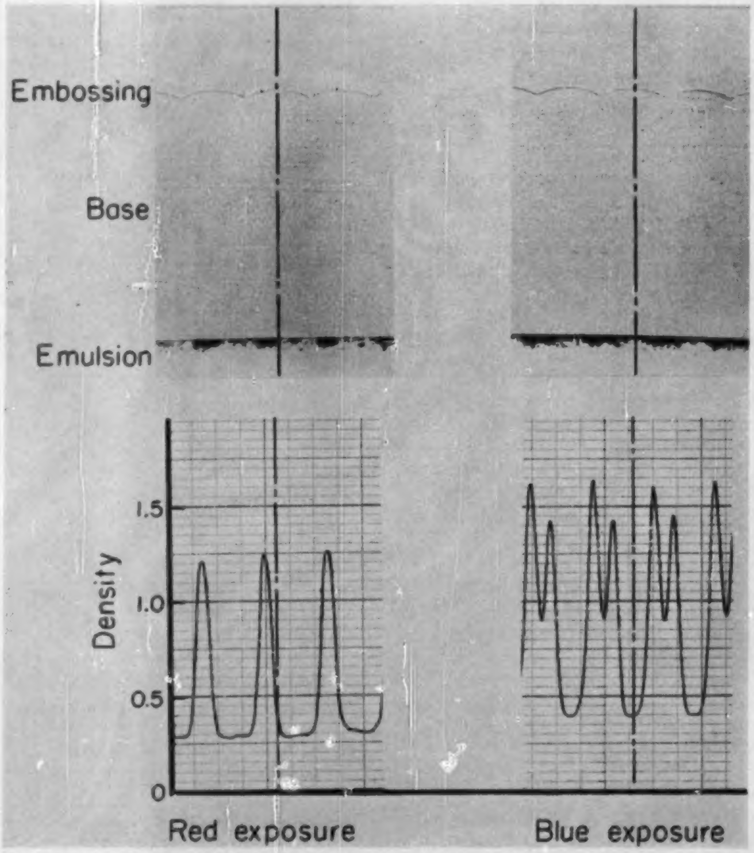

Fig. 1. Photomicrographs and microdensitometer traces of embossed film images.

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(This paper was received on October 15, 1956.)

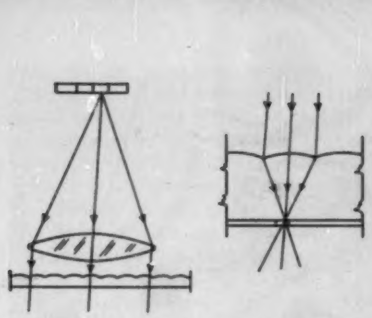


Fig. 2. Schematic diagram of an illumination system for embossed film densitometry.

ence between the image itself and the adjacent image areas which have received no exposure. This is a measure of the color separation in the process. The greater the density difference between the image and the adjacent areas the greater will be the color separation within the recorded image.

Microdensitometry of the color-separation images is undoubtedly the most analytical measurement which can be made of the nature of the image. The actual density distribution behind each embossed lens may be compared to the ideal image distribution. To the extent that there is density in areas which received no exposure, the image is imperfect. This unwanted density is produced by poor imaging in the optical system or by light scattered in the emulsion or at the embossed surface. The maximum color saturation possible with the film is the colorimetric mixture of the system primaries controlled by the actual density distribution in the emulsion. If the density in the red area, for example, averages 1.3 more than the density in the adjacent area, the resulting color upon projection will have twenty times as much green and blue primary present as red primary. The greater this density difference, the more saturated will be the resulting color.

Modified Densitometer

The advantages of microdensitometry are by no means slight. Most microdensitometers, however, are quite complicated and provide problems in instrument technique not normally found in the laboratory.[2] Essentially, it is the density of the image area which is required. This suggests that a properly modified densitometer could provide the required measurements. Such a measuring instrument should be no more complicated to operate than a standard densitometer. It should simulate the optical system in which the film is to be used, and it should give reproducible results.

Perhaps the simplest way to simulate the optical system with which the film is to be used is to arrange the illumination in the densitometer so that all of the light falling upon the film will be focused by the lenticules so as to pass through one of the image separation areas of the film. If the detector in the densitometer then collects all the light passing through the film, the density in the image separation area in question will be measured. Similarly, the other image areas can be read by changing the direction of the light incident upon the film.

A simple but adequate system is shown in Fig. 2. In this case, light is allowed to pass through an aperture placed at the focal point of the lens. The aperture is oriented relative to the optic axis of this lens so that light emerging from the aperture will be collimated by the lens and will strike the film at a fixed angle relative to the optic axis of the system. This parallel light is then focused by the lenticules on the film base to form an image of the rectangular aperture in the emulsion area. This is shown in the enlargement of the cross section of the film base in Fig. 2b.

In order to have the light pass through the proper image area, the angular size of the aperture measured from the principal point of the objective lens must be identical with the angular size of the image measured from the embossed film surface. When this condition is met, the other image areas will not be illuminated. Light will pass only through the desired image area, and the densitometer will indicate the correct density.

Fortunately, some densitometers are designed in such a way that an optical system similar to that shown in Fig. 2 is already a part of the design of the instrument. In this case, only slight modifications need be made to meet these optical requirements. A popular densitometer which can easily be modified is the Western Electric Densitometer, Type RA-1100B, commonly known as the Westrex Densitometer.[3]

In this densitometer, an objective lens forms an image of the light source upon the film surface placed upon an aperture. It is possible to place an aperture at the front focal plane of this objective lens so that the lens acts effectively in the same way as the lens in Fig. 2. Light from any point on the front focal plane of the lens leaves the rear of the lens as parallel light, as shown in a sketch of part of the optical system in Fig. 3. This parallel beam is then focused by the lenticules on the base of the film and is directed through the appropriate image area.

The shape of the aperture placed at the front focal plane of the objective lens need only be made to subtend the same angle relative to the principal points of the lens as does the aperture in the projection system used for the film. In this way, exactly conjugate results can be obtained from the densitometer to those obtained in the projection system.

In normal color kinescope recording, the angular size of the aperture is such that the red and the green images are exposed by an aperture subtending approximately $f/10$ at the film surface. Red and green apertures are located symmetrically on either side of the optic axis of the lens so that the total angular subtense of these red and green apertures totals $f/5$. The area outside of the red and the green apertures is used for the blue image, that is, between $f/5$ and $f/2.3$. Narrow guard bands, which are opaque, are inserted between each of the aperture positions. These guard bands customarily occupy approximately 10% of the total area of the aperture.

In order to calculate the size of the apertures required at the first focal plane of the objective lens of the densitometer, it is necessary only to measure the focal length of the objective lens. The aperture width can then be calculated very simply, since f-number $= f/w$, where f is the focal length of the objective lens and w is the width of the aperture slot.

The second condition is that this aperture be placed in the first focal plane of the objective lens. This point can be established on a conventional optical bench with very little trouble. The following example may not necessarily apply to other densitometers of the same model: The focal length measured for this instrument was 52 mm. This corresponds to an aperture width of 4.7 mm. This aperture should be placed 1 mm from the vertex of the first element of the lens in order to be in the front focal plane. It should be repeated that these values apply specifically to the first instrument modified and would not necessarily apply to other models. Later series of the instruments should have focal lengths close to these values.

Testing the Optical System

It would be useful to measure the effectiveness of this optical system in analyzing the three separation images. This can be done quite simply by replacing the normal aperture slide with a slide containing a narrow slit (1 mm) for the aperture. A film containing a

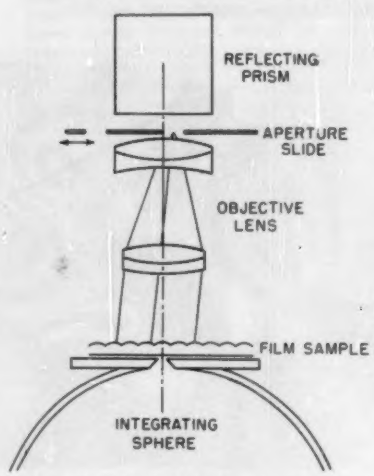


Fig. 3. Modified densitometer illumination system.

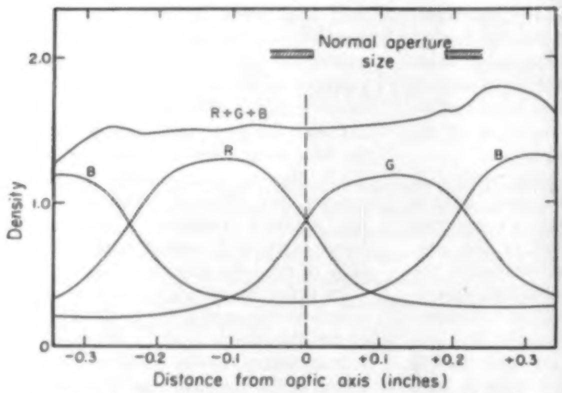


Fig. 4. Measured density distribution about optic axis of densitometer.

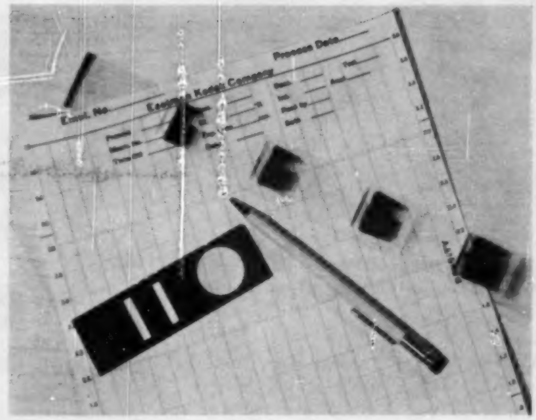


Fig. 5. Aperture plate for Westrex Densitometer.

single separation exposure is then placed in the densitometer and the small slit is slowly moved across the focal plane of the objective lens. Densities are read at a great many positions of the slit. Since the image of the slit is formed by the objective lens and lenticules in the plane of the emulsion, this slit image moves proportionately to the movement of the slit in the aperture slide. If the film sample contains only one separation exposure, there will be little density in the film except in the geometric area allotted to this separation image. This is illustrated by the microdensitometer trace shown in Fig. 1. When this slit image is outside of the geometric image, the density will be low. When the slit image moves into an exposed area, the density recorded will increase. A series of four exposures have been measured in this fashion and are shown in Fig. 4. These four film samples were exposed to a red-separation image exposure, a green-separation exposure, a blue-separation exposure, and the same exposure given to the red, green and blue separations together. The latter exposure corresponds to the neutral exposure on the film.

The average distributions of density behind the lenticules for these four exposures are presented together in Fig. 4. The densities of the single-separation exposures bear a marked resemblance to the microdensitometer trace in the earlier figure. The same quantity is being measured, though in two quite different fashions. The curves show that the image is largely confined to the geometric area provided for the separation but that some light is spilled into the adjacent areas. This spilled light results in a loss of density in the primary image and an increase in density in the adjacent areas. It is this loss in density that causes the neutral exposure to have a higher density than the same exposure given to the individual images which make up the neutral.

One of the differences between the microdensitometer trace and the trace obtained with the densitometer is the density difference between the peak density in the image and the density in the adjacent areas beside the image. This density difference is considerably greater for the microdensitometer trace than it is for the measurements in the densitometer. This effect can be explained since the density measured with the Westrex is diffuse density, whereas that measured with the microdensitometer is close to specular density. In normal use of the embossed film in a television projector, the specular density is the significant quantity; hence the larger density difference shown with the microdensitometer trace is perhaps a closer representation of the actual image obtained in projection. Since diffuse density can be related to specular density by multiplying it by the Q-Factor of the film and optical system combination, this does not represent a real handicap.

Shown at the top of Fig. 4 is the normal aperture size used for reading the red- or the green-separation image. The blue image is read by two apertures of this same size, located symmetrically on either side of the optic axis.

Dimensions of Aperture Plate

It would perhaps be useful as an example to show the dimensions of the actual aperture plate used. The aperture plate, shown in Fig. 5, is designed to read an image where the red and the green separations subtend $f/10$ on either side of the optic axis and the blue image

Fig. 6. Westrex Densitometer with cover removed and aperture plate in position.

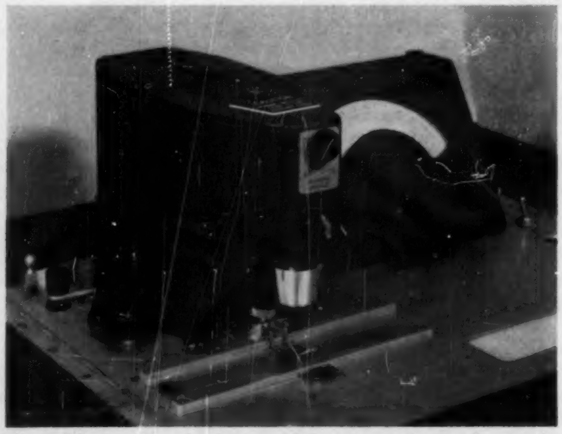


Fig. 7. Westrex Densitometer with aperture plate and cover in position for use.

subtends the remaining aperture from $f/5$ to $f/2.3$. The normal projection guard bands equal to 10% of the open area are inserted between these aperture slots. The position of the aperture plate relative to the optic axis is controlled by the detents on one edge of the slide. The large circular aperture at one end of the slide permits normal operation of the densitometer.

Only two rectangular slots are needed to read the densities of all three separation areas. As the slide is advanced across the focal plane of the objective lens, the first detent stops it so that one aperture is positioned on the righthand side of the optic axis and immediately adjacent to it. The second detent stops the same aperture on the lefthand side of the optic axis, corresponding to the second separation image position. The third detent stops the first aperture on the extreme lefthand side of the optic axis, at which time the second aperture is in position to let light pass through the extreme righthand side. Light from these two positions corresponds to the illumination required for the blue image. The detents which orient the aperture plate must be placed carefully relative to the optic axis of the objective lens.

The most convenient place to mount the aperture slide and slide holder in the Westrex Densitometer is on a prism holder directly above the objective lens. The completed modification with the aperture slide in this position is shown in Fig. 6. For clarity, the cover of the instrument has been removed. The slide can be seen on the righthand side of the prism mount. The instrument, with the cover in place, is shown in Fig. 7. The photographs indicate the mechanical simplicity of the modification.

Sensitometric Scales

A sample of the sensitometric scales measured with the instrument is shown in Fig. 8. The exposure from which these images were obtained was made as follows: An exposure intensity series was given to the area corresponding to the green-separation position only. This exposure was a normal sensitometric scale with equal steps in log exposure. No exposure was given to the red- or the blue-separation positions. The film was normally processed and then read in the densitometer. The densitometer indicated the density in the green-separation position, and this curve is indicated by the solid curve, "G," in the figure. The density in the red and the blue areas was also read. These densities are labeled "R" and "B" in the figure. Although no exposure was given in these regions, some density has been produced by light scatter and the other factors mentioned previously. The density of the green-separation position in a neutral exposure is shown by the dashed curve in the figure. The exposures given in the green-only and neutral exposures were identical. The loss of density shown by the difference between the dashed curve and the solid curve indicates the amount of light scattered out of the green image. In the case of the neutral exposure, the light scattered out of the green image is compensated for by light scattered into the image by the adjacent area exposure. In the green-only exposure, no such compensation occurs, hence an exposure loss from the image. The resulting loss in density is shown in the figure.

Sensitometric curves of this nature are very informative in the analysis of both the exposing and the projecting conditions for embossed-film images. If the aperture images are poor, there is considerable contamination in adjacent areas for exposure given to one of the separation areas. This loss of image separation will show up immediately in the densitometry by an increase in density of the adjacent exposure areas and in the density loss of the intentionally exposed area. Similarly, images which, upon densitometry, show good color separation should show good color saturation upon projection. If they do not, the optics of the projection system should be examined.

The ability to measure density in the separation images is fundamental to satisfactory use of an embossed film. This is particularly true if the optical system in which the film is being exposed and projected is of a new design. There are many pitfalls in the design of optical systems in which embossed films are used. Only with some method of adequate image analysis can the designer know with certainty that his system is functioning properly. It is hoped that the present densitometer modification will provide a useful method of image analysis.

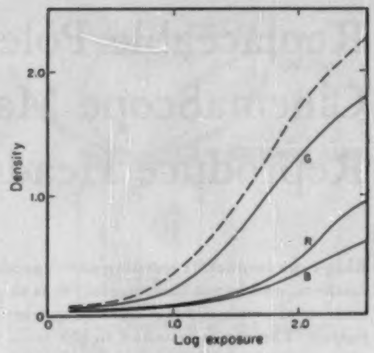


Fig. 8. Typical sensitometric curves of neutral and green exposures.

References

1. C. H. Evans and R. B. Smith, "Color kinescope recording on embossed film," *Jour. SMPTE*, **65**: 365–371, July 1956.
2. W. R. J. Brown, "A rapid-scanning microdensitometer," *Jour. SMPTE*, **63**: 147–150, Oct. 1954.
3. J. G. Frayne and G. R. Crane, "A precision integrating-sphere densitometer," *Jour. SMPE* **35**: 184–200, Aug. 1940.

Discussion

Louis Meeussen (Gevaert Co., Antwerp, Belgium): Why is the scattering of light into the red zone different from that into the blue one?

T. Gentry Veal (who read the paper, Eastman Kodak Co.): When the exposure is made through the green printing aperture only, for example, there is one blue sector which receives very little scattered light. The other blue zone will receive approximately the same amount of scattered light as the red zone from this single exposure.

Replaceable Pole Tip Caps for CinemaScope Magnetic Reproduce Heads

By MICHAEL RETTINGER

Ring-type magnetic recording and reproducing heads are contacted by the abrasive medium, and hence their useful life is shortened by wear, replaceable pole tip cap consists of a pair of brass holders in which the laminated tips of the cores are plasticized. The cap is fastened to the main housing assembly by means of two 1–72 screws, and locating pins are employed to assure correct azimuth on the part of the precision-aligned pole cap.

Ring-type magnetic recording and reproducing heads are contacted by the recording medium, and hence their useful life is shortened by a wear process. In this respect, light-scanning and photoelectric systems such as those used in theater soundheads are not subjected to such contact effects. Magnetic heads, therefore, resemble mechanical transducers such as phonograph styli, which are similarly worn away during the recording and reproducing processes, and must be replaced periodically.

The idea of employing a magnetic recording head with a replaceable recording tip, or cap, has no doubt occurred to many who have been engaged in the field of magnetic recording. There are even some patents describing such means.

It is the purpose here to describe some replaceable pole cap constructions which the author has studied or has built before the present design was developed. Figure 1A is a diagram of one type of replaceable pole cap consisting of two "cores" soldered to a brass rod in such a way that the "legs" can be slid into a mu-metal or Permalloy yoke which completes the magnetic circuit. To avoid high frequency losses, the "cores" cannot be much thicker than 0.006 in. In other words, a core is a single longitudinal lamination, bent at one end to form the recording tip, and left straight for the remainder so that it can be inserted into a magnetic yoke. However, because the depth of the front gap pole face is only 0.006 in., such a replaceable pole cap has to be replaced relatively often, and requires a good friction lock between leg and yoke to avoid displacement difficulties between the two. It might be said that these longitudinal laminations can be built up in layers, so that instead of a 0.006-in. front gap pole face depth, these depths become multiples of these dimensions (0.012 in., 0.018 in., etc.). However, in the life of such a head there must invariably come a time when a lamination has worn through and the recording medium rides not on a magnetic material but on a layer of cement or solder. In other words, it is difficult with such a multiple-layer cap to provide continuously satisfactory performance.

Types of replaceable pole caps.

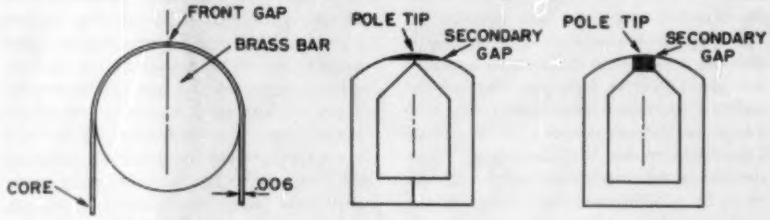


Figure 1A Figure 1B Figure 1C

Figure 1B shows another possible construction for a replaceable pole cap. The recording tip is cemented to the main core section in one manner or another, either by soldering or by using thermosetting resins. However, such a construction is afflicted with two very serious shortcomings. First, there exists so-called secondary gaps at the joints between the pole tip and the main core which give rise to undesirable low-frequency response variations. Second, the (solid) pole tip must again be made very thin to avoid high-frequency losses.

Figure 1C shows still another possible replaceable pole tip construction. Here, the pole face depth can be made any dimension within reason, for example, 0.050 in., but the secondary gap effect cannot be avoided. Also, the pole tip exchange cannot readily be made in the field because the construction requires disassembly and reassembly at the factory for the purpose of replacing the worn part. This is necessary because the pole faces, after being applied to the main core section, must be made flat, a spacer must be placed between them and the entire tip assembly must be ground and polished at the place where the recording medium contacts the recording tip.

Figure 2A shows another tip, essentially a single lamination core tip, which has been kept straight for the purpose of economy and for securing a tight friction lock between pole cap and the main core section. In this case, the corners of the replaceable pole cap give rise to violent low-frequency response variations because of a secondary gap effect similar to that produced by the construction shown in Figs. 1B and 1C. To avoid this shortcoming, concave sapphire spacers might be applied to the ends of the cap to introduce a varying air space between the extreme corners of the cap and the recording medium and a pressure roller used to force the film into the recording head cavity as shown in Fig. 2B. This construction, besides being costly, is cumbersome and, in the case of the stiff motion-picture film, practically impossible to use, although thin tape could possibly be pressed into the hollow of the cap.

The present construction (Fig. 2C) avoids all the difficulties associated with solid pole pieces, such as secondary gaps, pressure rollers, factory disassembly and reassembly, by utilizing a sturdily built laminated pole tip assembly which can be changed by anyone in the field, with the aid of a screw driver. Locating pins inserted in the main or basic cluster circumvent alignment problems when the replacement cap, with its corresponding locating pin holes, takes the place of the worn unit. The front gap pole face depth can be of the same order as that of the laminated head used heretofore. The main part of the pole

Presented on October 10, 1956, at the Society's Convention at Los Angeles by Michael Rettinger, RCA Engineering Products Div., Radio Corp. of America, 1560 N. Vine St., Hollywood 28.
(This paper was received on August 27, 1956.)

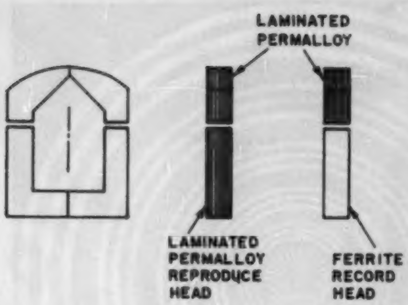


Fig. 2A. Single lamination core tip.

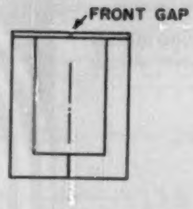


Fig. 2B. Pressure roller forcing film into recording head cavity.

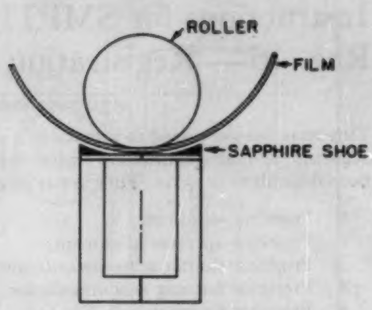


Fig. 2C. Construction of the present replaceable pole cap.

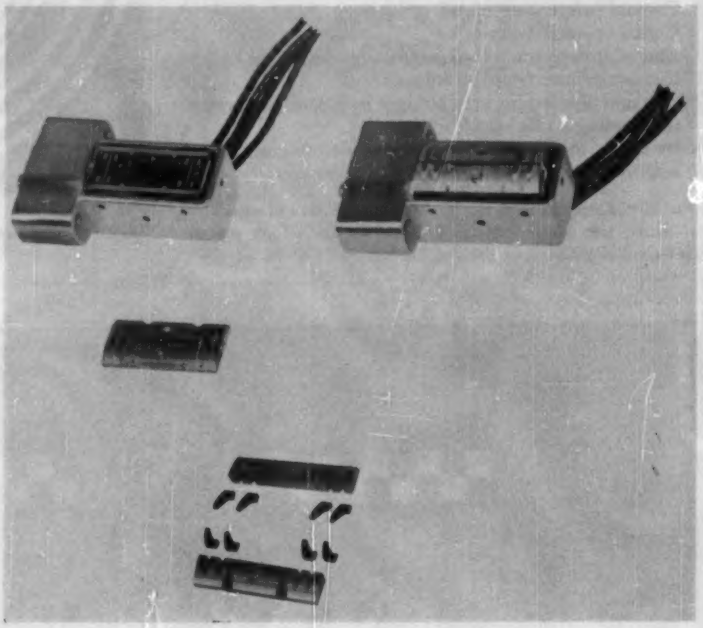


Fig. 2D. CinemaScope Magnetic Reproduce Cluster with replaceable pole cap.

cap, which consists of two solid machined brass holders, can be salvaged after the core tips have been worn away, and may be used again if desired.

Figure 2D shows the essentials of the construction of the present replaceable pole caps. The laminated Permalloy, mu-metal or Alfenol core tips are plasticized in brass holders with a special thermosetting casting resin. The front gap pole faces are then lapped as a unit on a diamond lap to assure that all faces are in the same plane. When the pertinent front gap spacers have been inserted between the two halves of the pole cap, the pair is screwed together.

The construction of the main cluster follows the method of fabrication employed with our regular magnetic head clusters, except that 0.200 in. is ground away from the core tips to provide a flat surface for the replaceable pole tip cap.

Because two additional air gaps are introduced into the construction, the reluctance of the magnetic circuit is increased. To compensate for the lowered inductance (as produced by the increased reluctance), additional turns of wire are required on the cores. The slightly lowered 1000-cycle sensitivity was corrected by employing a slightly thicker front-gap and a slightly thinner back-gap spacer. Although the front-gap spacer used previously was 0.0003 in. and the new front-gap spacer was made 0.0005 in. thick, this spacer thickness increase had no effect on the high-frequency response of the unit since the film speed is relatively high (90 ft/min). Actually the *effective* gap before was in the order of 0.0007 in., while the new gap length is in the order of 0.0010 in.

Difficulties were at first experienced in the use of this type of head as a recording head because of increased bias current requirements. This was undoubtedly due to the two additional air gaps contained in the construction. The surfaces of these gaps become work-hardened and thereby represent a relatively high reluctance to the 68-kc bias flux. The extra magnetomotive force required for the flux to be able to bridge these gaps must be made up by increasing the magnetizing force, in this case the bias current.

This shortcoming was corrected by mounting the laminated Permalloy pole tip cap on a substructure of solid ferrite cores instead of laminated cores. The lower bias current required by such a unit is in all probability due to the lower reluctance of the cores themselves, because the eddy current losses of ferrite are relatively small, and may also be due to the two additional gap surfaces not having become work-hardened, because ferrite is not a metal but a sintered ferrous oxide.

Acknowledgments

The author wishes to give credit to the competitive stimulus provided by Ray Warren, of the Advanced Development Group of RCA, Camden, N.J., who worked on a magnetic head with a replaceable pole cap using solid Alfenol tips; and especially to W. L. Tesch, Manager, Film Recording Equipment Planning, who showed so much interest and encouragement in the project.

Discussion

R. A. Isberg (Ampex Corp., Palo Alto, Calif.): Can you comment about the wearing qualities of Alfenol compared to Permalloy?

Mr. Rettinger: There's no question but that the Alfenol will last considerably longer than laminated Permalloy. The laminated Alfenol tip will last longer than the laminated Permalloy tip, but the difficulty has been to obtain laminated Alfenol because it is so extremely hard to roll; so far it has only been available in experimental samples. What the exact wear ratio is I'm not sure. So as far as this laminated type of cap construction is concerned it makes little difference what pole tip material we use, Permalloy or Alfenol — but with replaceable pole cap constructions which consist of solid pole tips, it becomes very important what material is used.

Lloyd Goldsmith, (Warner Bros.): Is it anticipated that this replaceable pole cap tip construction might be applied and furnished with your single-track, three-track perhaps, and six-track heads?

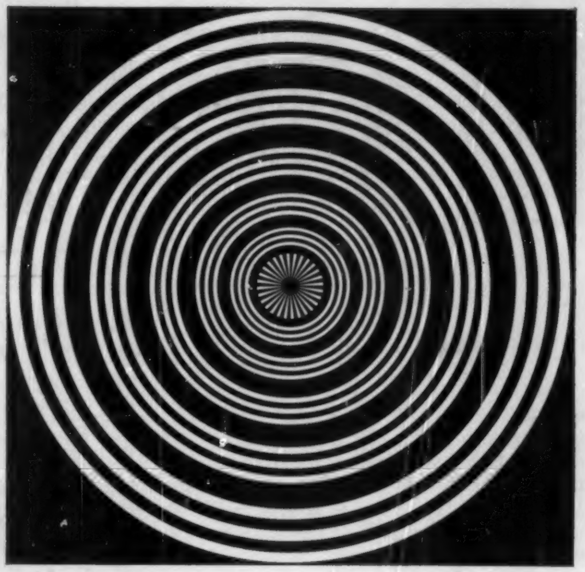
Mr. Rettinger: Yes, it is practical to employ it with any type of magnetic head. We have used it so far chiefly for CinemaScope reproduce heads of which we have several hundred in the field, and which has worked out very well. Whether we shall employ it also for recording heads for studio installations is something that shall have to consider.

Instructions for SMPTE Reg-16 — Registration Test Film

THIS FILM was developed to provide in a single test film of high accuracy several quantitative visual tests that have always been difficult to perform. They are as follows:

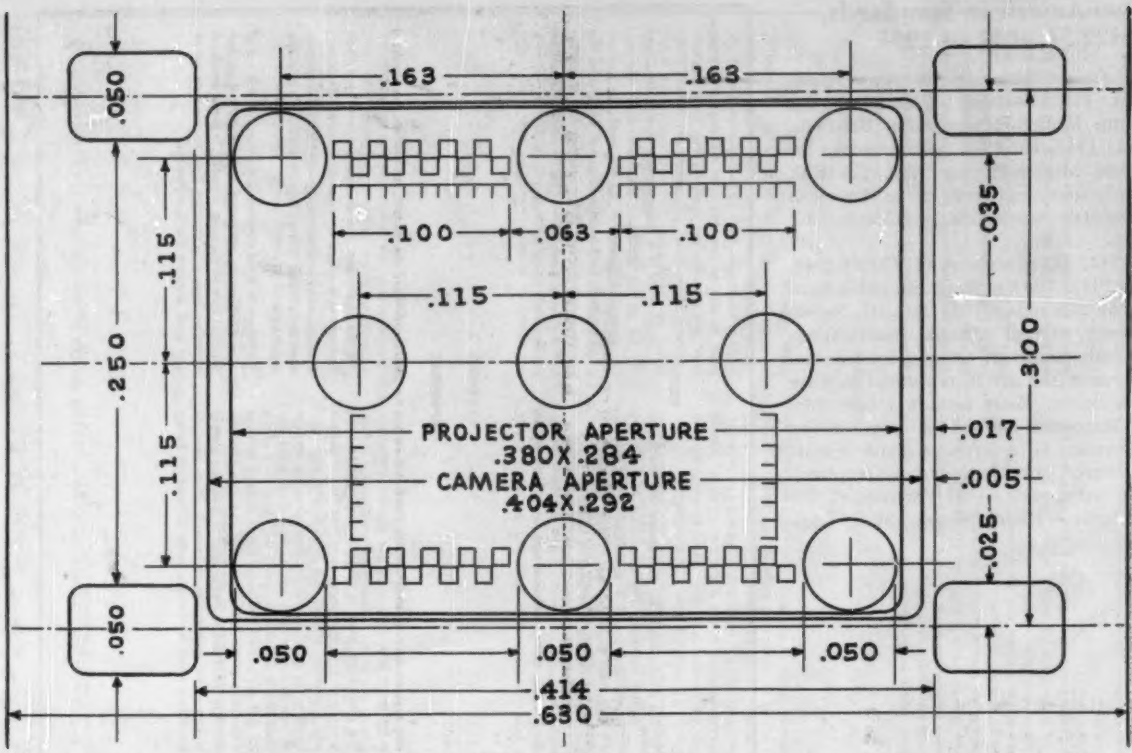
1. Projector steadiness;
2. Projector aperture alignment;
3. Projector shutter adjustment (travel ghost);
4. Projector framing accommodation;
5. Projector focusing;
6. Optical printer alignment;
7. Optical projector focusing;
8. Contact printer resolution;
9. Contact printer weave;
10. Contact printer double-exposure alignment;
11. Contact printer (step) steadiness;
12. A frame of this film may be used in a camera aperture for aligning a title stand;
13. By laying the scale on this film emulsion to emulsion on a sound record, its location may be measured.

If the film is projected to 30 × 40 in. it will be enlarged 100 times. Since the 1-mil scale is 1/10 of an inch long on the film, it becomes 10 in. long on a picture of 30 × 40 in.



Detail of the frame content.

CORRECTION: The above shows the content of a frame of the REG-16 Test Film which is a positive print having a black background — contrary to the illustration published on p. 436 of the August 1956 Journal.



Dimensions of REG-16 — Registration Test Film. Aperture dimensions are in accordance with PH22.7 and PH22.8.

(1) The test film is a positive print having a black background with all copy white or transparent. The film stock used has high resolution and has been accurately perforated both edges one frame interval at a time so that the steadiness of each frame will be in respect to its perforation.

(2) The dimensions were obtained from present standards and adjusted to units of 1 mil and either represent the ideal condition or an average one in practice. For instance, the outside rectangle represents the camera aperture and the rectangle just inside, the projector aperture. The inside line should project on the screen in all projectors if designed according to SMPTE standards. If the camera aperture line should show in projection it would present an extremely large projector aperture.

(3) Resolution targets are spaced one in the center, four equidistant from the center and one in each of the four corners. The outside diameter of target on the film is 50 mils and will fill the area covered by an average microscope using a 10× objective. The original drawing of the target was laid out to an accuracy of 1 mil at 200 times size, i.e., 20 in. on the drawing reduces to 50 mils on the film.

(4) The white blocks are 10 mils square and will quickly indicate travel ghost caused by incorrect shutter adjustment. They also provide a quick check on the ability to frame above and below center position.

(5) The vertical rows of numbers 20, 30, etc., refer to lines per millimeter in the concentric rings of the resolution targets and also provide title size copy for rough focusing.

(6) The scales provide detailed copy on the chart and represent thousanths of an inch. These are helpful when film is double exposed in a printer to check registration.

(7) The copy on either side of the center target provides more fine detail and explains resolution targets.

(8) The lines adjacent to the sprocket-hole outline provide a means for accurately adjusting the image of the master chart to the film while being photographed.

(9) The triangular areas in the centers of the vertical and horizontal frame lines provide a means of measuring the amount of jump and weave and as a gauge for centering the film in the aperture laterally. Each line is 1 mil thick and spaced 1 mil. Count the white lines as 1 mil and the space between as 1 mil. Two white lines and a space total 3 mils or 0.003 in.

Two American Standards, PH22.34, .102 — 1956

Published here are American Standards PH22.34–1956, Dimensions for 35mm Motion-Picture Film, BH-1870, and PH22.102-1956, Dimensions for 35mm Motion-Picture Film, CS-1870, which were approved by the American Standards Association on October 10, 1956.

PH22.34, a revision of Z22.34-1949, and PH22.102 had their trial publication in the November 1955 Journal. Subsequently, several editorial modifications of both standards were proposed and approved and are incorporated in these final drafts. These include a new title, an improved method of diagramming dimension G, a limiting scope, formal numbered specifications, two explanatory notes and a slight revision of the appendix.—Henry Kogel, Staff Engineer.

AMERICAN STANDARD

Dimensions for 35mm Motion-Picture Film, BH-1870

ASA Reg. U.S. Pat. Off.

PH22.34-1956

(Revision of Z22.34-1949)

*UDC 778.534:771.531.3

Page 1 of 2 pages

1. Scope

1.1 This standard specifies the cutting and perforating dimensions of the 35mm motion-picture film with a Bell & Howell type perforation and a perforation pitch of 0.1870 in.

1.2 This film is used mostly as camera original or negative film.

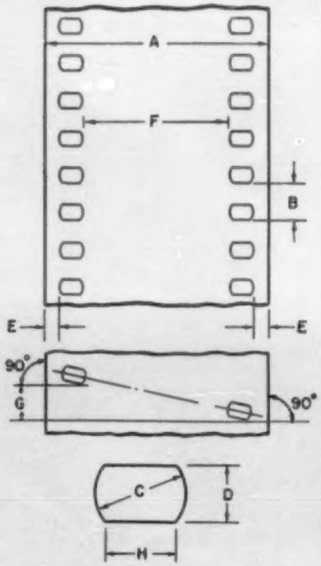
1.3 Dimensionally, this standard differs from American Standard Dimensions for 35mm Motion-Picture Short-Pitch Negative Film, PH22.93-1953, only in the values of B and L.

2. Dimensions

2.1 The dimensions shall be as given in the diagram and table and refer to the film immediately after cutting and perforating.

2.2 Dimension H is a calculated value for a dimension not measured routinely in production.

2.3 Dimension L represents the length of any 100 consecutive perforation intervals.



Dimensions	Inches	Millimeters
A	1.377 ± 0.001	34.98 ± 0.03
B	0.1870 ± 0.0005	4.750 ± 0.013
C	0.1100 ± 0.0004	2.794 ± 0.010
D	0.0730 ± 0.0004	1.854 ± 0.010
E	0.079 ± 0.002	2.01 ± 0.05
F	0.999 ± 0.002	25.37 ± 0.05
G	0.001 max	0.025 max
H	0.082	2.08
L	18.700 ± 0.015	474.98 ± 0.38

Approved October 10, 1956 by the American Standards Association, Incorporated
Sponsor: Society of Motion Picture and Television Engineers

*Universal Decimal Classification

70 East Forty-fifth Street, New York 17, N.Y.

Printed in U.S.A. ASA%M1256

Price, 25 Cents

Page 2 of 2 pages

NOTES:

1. The dimensions in the inch system are the fundamental standard. The dimensions in the metric system are practical approximations based on American Standard B48.1-1933 reaffirmed in 1947 providing a conversion factor of 1 inch = 25.4 millimeters.
2. The title of this standard was established by the application of a nomenclature system developed for all film dimension standards: Each title provides an indication of the film width, the perforation pitch (without the decimal point) and the perforation shape (BH, KS, DH or CS) or number of rows of perforations (1R, 2R or 4R), depending on which is the significant factor.

APPENDIX

(This Appendix is not a part of American Standard Dimensions for 35mm Motion-Picture Film, BH-1870, PH22.34-1956, but is included to facilitate its use.)

The dimensions given in this standard represent the practice of film manufacturers in that the dimensions and tolerances are for film immediately after perforation. The punches and dies themselves are made to tolerances considerably smaller than those given, but since film is a plastic material, the dimensions of the slit and perforated film never agree exactly with the dimensions of the slitters, punches and dies. Film can shrink or swell due to loss or gain in moisture content or can shrink due to loss of solvent. These changes invariably result in changes in the dimensions during the life of the film. The change is generally uniform throughout a roll.

The uniformity of pitch, margin and hole size (Dimensions B, C, D and E) is an important variable affecting steadiness.

Variations in these dimensions from roll to roll are of little significance compared to variations from one sprocket hole to the next. Actually, it is the maximum variation from one sprocket hole to the next within any small distance that is important.

PH22.34-1956

AMERICAN STANDARD

Dimensions for 35mm Motion-Picture Film, CS-1870

ASA
Reg U.S. Pat. Off

PH22.102-1956

*UDC 778.534.771.531.3

1. Scope

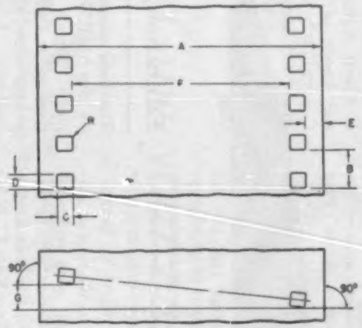
1.1 This standard specifies the cutting and perforating dimensions of the 35mm motion-picture film with a CinemaScope-type perforation and a perforation pitch of 0.1870 in.

1.2 This film is used mostly for anamorphic release prints. (See Appendixes 2 and 3.)

2. Dimensions

2.1 The dimensions shall be as given in the diagram and table and refer to the film immediately after cutting and perforating.

2.2 Dimension L represents the length of any 100 consecutive perforation intervals.



Dimensions	Inches		Millimeters	
A	1.377	± 0.001	34.98	± 0.03
B	0.1870	± 0.0005	4.750	± 0.013
C	0.0780	± 0.0004	1.981	± 0.010
D	0.0730	± 0.0004	1.854	± 0.010
E	0.086	± 0.002	2.18	± 0.05
F	1.049	± 0.002	26.64	± 0.05
G	0.001	max	0.025	max
L	18.700	± 0.015	474.98	± 0.38
R	0.013		0.33	

NOTES:

1 The dimensions in the inch system are the fundamental standard. The dimensions in the metric system are practical approximations based on American Standard B48.1-1933 reaffirmed in 1947 providing a conversion factor of 1 inch = 25.4 millimeters.

2. The title of this standard was established by the application of a nomenclature system developed for all film dimension standards: Each title provides an indication of the film width, the perforation pitch (without the decimal point) and the perforation shape (BH, KS, DH or CS) or number of rows of perforations (1R, 2R or 4R), depending on which is the significant factor.

Approved October 10, 1956 by the American Standards Association, Incorporated
Sponsor: Society of Motion Picture and Television Engineers

*Universal Decimal Classification

Printed in U.S.A.
ASA&M1256

Price, 25 Cents

(Appendixes 1, 2, and 3 are not a part of American Standard Dimensions for 35mm Motion-Picture Film, CS-1870, PH22.102-1956, but are included to facilitate its use.)

APPENDIX 1

The dimensions given in this standard represent the practice of film manufacturers in that the dimensions are for film immediately after perforation. The punches and dies themselves are made to tolerances considerably smaller than those given, but since film is a plastic material, the dimensions of the slit and perforated film never agree exactly with the dimensions of the slitters, punches, and dies. Film can shrink or swell due to loss or gain in moisture content or can shrink due to loss of solvent. These changes invariably result in changes in the dimensions during the life of the film. The change is generally uniform throughout a roll.

The uniformity of pitch, margin, and hole size (Dimensions B, C, D, and E) is an important variable affecting steadiness. Variations, in these dimensions, from roll to roll are of little significance compared to variations from one sprocket hole to the next. Actually, it is the maximum variation from one sprocket hole to the next within any small distance that is important.

APPENDIX 2

It should be particularly noted that film made to this standard will not fit over pins and sprocket teeth designed to fit film perforated to the following American Standards: Dimensions for 35mm Motion-Picture Film, Alternate Standards for Either Positive or Negative Raw Stock, PH22.1-1953; Dimensions for 35mm Motion-Picture Film, BH-1870, PH22.34-1956; Dimensions for 35mm Motion-Picture Positive Raw Stock, PH22.36-1954; Dimensions for 35mm Motion-Picture Short-Pitch Negative Film, PH22.93-1953.

The perforation hole size shown in the American Standards listed above is 0.073 x 0.110 in., except for PH22.36-1954 which has 0.078 x 0.110 in. holes, whereas, for this new standard, the hole size is 0.073 x 0.078 in. Films with holes of this size would be injured at the perforation edges when run on standard sprockets or pins carried by most 35mm film handling apparatus. New or modified sprockets and pins designed to accept the 0.073 x 0.078 in. hole, however, can be used in conjunction with film perforated to the other existing 35mm motion-picture film standards.

The wear life of film perforated in this manner should be nearly equal to that of film having other standard perforations. Experience has shown, however, that the wear life obtained with these perforations, as well as that obtained with other standard types of perforations, can be greatly extended by the use of intermittent sprockets having a base diameter of 0.950 in. to 0.953 in. in place of sprockets of lesser diameter.

APPENDIX 3

Most 35mm motion-picture films produced prior to 1954 were perforated with two rows of perforations, each perforation being 0.110 x 0.078 in. for positive film or 0.110 x 0.073 in. for negative film or both. Such film, in addition to carrying the picture, accommodates a single sound record between one row of perforations and the picture frame. The desire to reproduce multichannel sound on the same film that carries the picture image, and yet not reduce the image size, led to the use of smaller perforations on positive film. Films perforated to this smaller perforation standard have wider margins (dimension E) and wider usable film areas between the rows of perforations than positive films perforated to American Standards PH22.1-1953 and PH22.36-1954. This permits the placement of a magnetic coating for the multichannel sound record along both edges just outside the perforations and along both sides of the picture just inside the perforations.

news and reports

81st Convention Program

The Spring Convention, in Washington, will be distinguished by the variety and extent of the topics presented rather than by the exploration of a single theme, attempted often in the past. The Convention's new look represents gradual evolution and intensification of organization by subject areas.

For several years, television, high-speed photography and screen brightness have intermittently been the responsibility of subject or topic chairmen; now there are ten topic chairmen. The organization of Convention committees and the distribution of responsibility have been changed to conform with a logical pattern of planning, with the aim of contributing to the success of the total Convention structure. For the 81st Convention:

Program Chairman: *Joseph E. Aiken*, 116 North Galveston St., Arlington 3, Va.

TOPIC CHAIRMEN

Audio-Visual Uses of Motion Pictures and Television: *John Flory*, Advisor on Nontheatrical Films, Eastman Kodak Co., 343 State St., Rochester 4, N. Y.

Cinematography: *John A. Maurer*; JM Developments, Inc., 116–118 West 29th St., New York 1, N.Y.

Film Projection and Viewing: *Herbert E. Behrens*, 31 Sheridan Ave., Metuchen, N. J.

Theater Operation: *Fred E. Aufhauser*, Projection Optics Co., Inc., 330 Lyell Ave., Rochester 6, N.Y.

Industry Milestones: *Don G. Malkames*, 7 Plymouth Ave., Tuckahoe, N.Y.

Instrumentation and High-Speed Photography: *John H. Waddell*, Fairchild Camera and Instrument Corp., 88-06 Van Wyck Blvd., Jamaica 1, N.Y.

Laboratory Practice: *Garland C. Misener*, Capital Film Laboratories, Inc., 1705 Fairview Ave., N.E., Washington 20, D.C.

Sound Recording and Reproduction: *Jack C. Greenfield*, 3201 Park Dr., S.E., Washington 20, D.C.

Standards and Standardization: *Ellis W. D'Arcy*, Box 1103, Ogden Dunes, Gary, Ind.

Television: *Ralph N. Harmon*, Vice-President for Engineering, Westinghouse Broadcasting Co., 122 East 42nd St., New York 17, N.Y.

Author's Forms are available from the above, from any member of the Papers Committee (p. 7 of the April 1956 *Membership Directory*), or from the Regional Chairmen.

REGIONAL CHAIRMAN

Those formerly called Vice-Chairmen of the Papers Committee are now Regional Chairmen, Papers Committee. This comparatively small change was made chiefly for clarity. A prospective author can be expected to understand the difference in function between a Topic Chairman and a Regional Chairman, either of whom may approach him to solicit a paper. The roster of Papers Committee Regional Chairmen for 1957-58 as announced by Glenn E. Matthews, Editorial Vice-President, is as follows:

Joseph E. Aiken — **Washington area** — 116 N. Galveston St., Arlington 3, Va.

Ben Akerman — **Atlanta area** — 2624 Cheshire Bridge, Rd., N.E., Atlanta 5, Ga.

Herbert E. Farmer — **Hollywood area** — 7826 Dumbarton Ave., Los Angeles 45, Calif.

C. L. Graham — **Rochester area** — 500 Thomas Ave., Rochester 12, N.Y.

R. A. Isberg — **San Francisco area** — 2001 Barbara Dr., Palo Alto, Calif.

Everett Miller — **New York area** — 94 Rossmore Ave., Bronxville 8, N.Y.

Ira L. Miller, Jr., — **Dallas-Ft. Worth area** — Miller's Visual Aids, 519 Pennsylvania Ave., Ft. Worth, Tex.

C. E. Heppberger — **Chicago area** — 231 N. Mill St., Naperville, Ill.

Rodger J. Ross — **Canadian area** — 784 Duchess Dr., Applewood Acres, Port Credit, Ont., Canada

Deane R. White — **New Jersey/Philadelphia area** — E. I. du Pont de Nemours & Co., Parlin, N.J.

Looking six months further ahead — the 82d Convention, to be held at Philadelphia, will be a program under the chairmanship of Deane R. White, whom we are most fortunate to have for this convention in a new location.

The program of the motion-picture short subjects which will introduce each technical session of the 81st Convention will be arranged by Ethan M. Stifle, Eastman Kodak Co., 342 Madison Ave., New York 17, N.Y.

EXHIBITS

As a location for shows and exhibits Washington is a natural, and the widespread interest that exists in various government departments in the kind of professional equipment usually shown at SMPTE conventions makes this an especially good opportunity for exhibitors. Walt Trimby, the Exhibit Chairman for this convention, is arranging with the Shoreham for some very attractive space and expects to have a floor plan and full information out in the mail to potential exhibitors about the time that this issue of the *Journal* appears.

Space at these exhibits is allocated strictly in accordance with the order in which applications are received. Several such requests are already in, and anyone who wants to be sure of getting a bid in even before the printed forms are received should contact Walt immediately. His address is: *Walter W. Trimby*, SMPTE Exhibit Chairman, 1627 Preston Rd., Alexandria, Va.

Special interest has been aroused for this Convention by a tentatively scheduled group of papers under the general heading of Audio-Visual Uses of Motion Pictures and Television. This portion of the program is expected to encompass such subjects as the economic impact of the audio-visual field, variously elaborate or simple projection equipment and materials, new equipment and closed-circuit television.

The projected session on Industry Milestones will include a description and introduction for the Motion Picture Collection at the Smithsonian Institution which members can visit during the Convention to see the collection which includes much equipment.

An important omen for the 81st Convention is that many of those listed above have been at work for months, working out the format and getting tentative commitments for papers and demonstrations.

Prospective authors who are not certain about choosing a Topic Chairman or Regional Chairman from the above, should write direct to Program Chairman Joseph E. Aiken. Author's Forms are due back in the hands of those responsible for the Convention by or before March 1; and the completed manuscript must be submitted to the Society's Editor before March 29.—*Bernard D. Plakun*, Papers Committee Chairman.

Education, Industry News

Two new education courses, co-sponsored by the SMPTE and the IATSE, will be given through New York University beginning in February 1957. These courses were planned by two subcommittees of the Society's Education Committee — the Sound Recording Subcommittee, under the chairmanship of Edgar A. Schuller of DeLuxe Laboratories; and the Laboratory Practice Subcommittee, under the chairmanship of James W. Kaylor of Movielab.

A twenty-week course in Elements of Motion Picture Sound Recording, designed to improve the technical ability of persons now actively engaged in sound recording, will cover basic principles of electricity, sound and acoustics; present day recording methods, materials, equipment and personnel; production and maintenance techniques and procedures; and factors governing sound recording quality. Classes will meet on Wednesday evenings from 7:30 to 10:00 and will be taught by leading men in the sound recording field. Tuition, which

will ultimately depend on the number of registrants, will probably be between $30 and $50.

The course in Motion Picture Laboratory Practice will run for eighteen weeks and will cover basic photographic processes, fundamental optics, sensitometry, motion-picture developing and printing, chemical and quality control, and the processing of color films.

Applications for these courses should be sent to SMPTE headquarters and should cover name, address, education, age, present position, experience in sound recording/laboratory practice, and other allied experience. Final information on instructors, tuition, and date and place of registration will be sent to those applying.—*S.G.*

The Rochester Institute of Technology has added a course major to the Department of Photography. Candidates for the degree of Bachelor of Fine Arts may major in Professional and Applied Photography beginning with the next school year. The department formerly awarded degrees only in Photographic Science and Illustrative Photography.

UCLA's closed-circuit television system was used to permit students in the University's Medical Center Hospital to watch the Homecoming parade. Rudy Bretz, head of the school's Television-Radio Division, produced the broadcast assisted by a crew of 15 students. This production was one in a series of remote telecasts planned by Bretz for student training. Although vidicon cameras were used in this outdoor night telecast, it is reported that no more lighting was used than would have been necessary for standard image-orthicon pickup.

A list of 145 films on Atomic Energy and related subjects is contained in the October 1956 issue of the *Scientific Film Review*, published by the Scientific Film Association, 164 Shaftesbury Ave., London, WC2. The information is arranged alphabetically by film title and includes a description of each film. Copies are available from the publisher at 3/6d each.

Electronic News, a weekly newspaper for the electronics industry begins publication on January 21. The new publication is edited for management and engineers. Introductory subscription rate is $2.00 for 3 years or $1.00 a year. Orders may be sent to Fairchild Publications, 7 E. 12th St., New York 3.

The National Audio-Visual Association has moved its headquarters from Evanston, Ill., to Fairfax, Va. The Association has issued the 3rd edition of the Audio-Visual Equipment Directory. The 197-page directory reflects the expansion taking place in the industry and in all audio-visual applications. Not only are there more equipment items, but changes in design and the addition of new sources of supply are significant of progress throughout the industry. The editor of the new directory is Robert J. Schmidt, NAVA Director of Services, and the associate editor is Henry C. Ruark, Jr., Associate, Audio-Visual Center, Indiana University.

section reports

Something unusual in SMPTE Section activity was witnessed in November when the **Chicago Section** held its annual Regional Meeting in Detroit. Over 200 members registered for the sessions which were held on Friday and Saturday, November 9 and 10, in the headquarters of General Motors Photographic.

The meeting was a grand success technically and socially. Nine top-notch papers were presented during the meeting, covering all phases of motion-picture production. General Motors was host at a cocktail party preceding dinner on Friday night. A total of 155 people attended the dinner.

Much of the success of the meeting was due in no little part to the efforts of Bill Smith, Lakeside Laboratory, Gary, Program Chairman for the Chicago Section; Jim Bostwick and Mike Omalev of General Motors Photographic, local arrangements chairmen, and the nine speakers themselves.

Equipment available for the meeting included two 16mm arc projectors, two 35mm arc projectors, lantern slide projectors and 2 × 2 standard and wide-screen.

Twenty-nine members from Chicago were transported to Detroit on a special New York Central excursion. They were met by chartered bus in Detroit and carried to the Park Shelton Hotel where rooms had already been assigned to each person. Several other out-of-town members arrived by plane and private car.

The award for attendance goes to the University of Indiana which not only had three members of its Audio-Visual Staff present, but also 18 foreign exchange students. It was learned from Warren Stevens of the Indiana Audio-Visual Center that these students will return to their respective countries and be involved in the production of educational films.

Papers included "New Techniques in Wild Life Photography," Mort Neff, producer of the TV show *Michigan Outdoors;* "The Bi-Matic Projector," John Campbell, Jam Handy; "High-Speed Photography Instrumentation," Richard Painter, General Motors; "A New Intermediate Positive Duplicate Negative System," Daan Zwick, Eastman Kodak; "A Wide-Screen Color Photographic Report from Russia," Lloyd Thompson, The Calvin Company; "Editing ½-Inch Tape for Lip Sync Recording," Gordon Ellsworth, General Motors; "Problems of the Small Producer," Ray Balousek, Producers Color Service; "New 16mm Color Camera Films," William Metzger, Ansco; and "A New Continuous Contact 16mm Color Printer," Paul Ireland, E.D.L. Co.—*Ken Mason*, Chairman, Central Section; c/o Midwest Div., Motion-Picture Film Dept., Eastman Kodak Co., 130 N.E. Randolph Dr., Chicago 1.

A meeting of the Officers and Managers of the San Francisco Section was held October 4 at the Tokyo Sukiyaki at Fishermans Wharf, San Francisco. Officers and Managers for the coming year are: Chairman, R. A. Isberg; Secretary-Treasurer, Werner Rhuel; Managers for a 2-year period, Lee Berryhill, W. A. Palmer, W. E. Evans; Managers for a 1-year period, Harry Jacobs Ross Snyder, Walter Ball. The meeting was attended by E. M. Stifle, Sections Vice-President, who described the policies relating to section organization and administration.—*R. A. Isberg.*

The San Francisco Section met October 23 at Ampex Corp. headquarters, Redwood City, Calif. R. J. Tinkham, Manager,

Speakers at the Detroit Regional meeting: seated, left to right, are: Richard O. Painter, General Motors; John Campbell, Jam Handy; James Bostwick, General Motors; and standing, left to right: Ken Mason, Eastman Kodak; Ray Balousek, Producers Color Service; Daan Zwick, Eastman Kodak; Lloyd Thompson, The Calvin Company; Gordon Ellsworth, General Motors; and Bill Smith, Lakeside Laboratory.

Audio Custom Eng., Ampex Corp., addressed an audience of 40 persons on "The Solution to Some Problems of Making Master Tapes." R. H. Snyder, Manager, Video Tape Recorder Sales, Ampex Corp. gave a "Progress Report on Video Tape Recording." The Progress Report summarized the information presented at the SMPTE Fall Convention. The paper is recorded and is available to other sections. —*R. A. Isberg*, Secretary-Treasurer; Consulting Television Engineer, 2001 Barbara Dr., Palo Alto, Calif.

The Washington D.C. Section held its first meeting October 22 in the General Services Building Auditorium with an attendance of 200. The speakers were Walter D. Goldsmith, Ampex Corp., Redwood City, Calif., who presented a paper on "The Modulation System of the Ampex Videotape Recorder"; and John A. Maurer President, JM Developments, Inc., New York, who spoke on "Developmental Possibilities in 16mm Projection Equipment." E. M. Stifle, SMPTE Sections Vice-President, attended the meeting and spoke briefly on the history and growth of the Society and described the highlights of the 80th Convention. Chairman of the new Section is Keith B. Lewis. Members of the Board of Managers are: James M. Barker, Howland Pike, Nathan D. Golden, Jack C. Greenfield, Philip M. Cowett and Watson P. Dutton.—*James A. Moses*, Secretary-Treasurer, c/o Film Distribution, Army Pictorial Center, Washington 25, D.C.

The Rochester Section met October 27 at Shelly Films, Ltd., Toronto, Ontario, Canada. The speakers were Roger J. Beaudry, Shelly Films Ltd., Toronto; Chester E. Beachell, National Film Board, Montreal; Edwin C. Fritts, Eastman Kodak Co., Rochester, N.Y.; N. H. Grover, Canadian Broadcasting Corp., Montreal (who read a paper prepared by Stanley Wilson, C.B.C., Montreal); and Richard C. Gearhart, Eastman Kodak Co. Titles of the papers presented (in that order) are: "16mm Magnetic Striping Applications," "National Film Board Sprocketape Magnetic Recorder," "Magnetic Sound Reproduction With Eastman Projectors, Model 25 and Model 250," "Application of Magnetic Sound in TV at C.B.C.," "Use of Kodak Pageant Projectors for Producing Lip Sync Sound." Rodger J. Ross of C.B.C., Toronto, acted as chairman of the meeting.

This meeting is the first of the Rochester Section to be held outside the Rochester area. Approximately 100 members and guests were present. About 50 persons attending were from the Toronto area, about 20 from Rochester and the remainder from Montreal; London, Ontario; Buffalo; Ottawa; Boston and Chicago.—*G. T. Negus.*

Ralph M. Evans addressed **The Rochester Section** on "Sharpness and Contrast in Projected Pictures" November 29 at the George Eastman House, Rochester, N.Y. Mr. Evans is Director of the Color Technology Division of Eastman Kodak Co. He had previously presented his paper at the Society's Fall Convention at Los Angeles. Approximately 60 members and guests attended the section meeting.—*G. T. Negus*, Secretary-Treasurer, c/o Eastman Kodak Co., Kodak Park Works, Bldg. 65, Color Technology Div., Rochester 4, N.Y.

The Hollywood Section met November 20 at the Paramount-Sunset Corp. Studios, Hollywood. An audience of 345 heard Phil Adamson, Senior Staff Engineer, Hughes Systems Development Laboratories, speak on Elements of Automation. Panel members for the inter-panel and open discussion were: N. L. Simmons, Eastman Kodak Co., moderator; John Livadary, Columbia Pictures; Harlan L. Baumbach, Unicorn Engr. Corp.; L. B. Abbott, 20th Century-Fox; Gordon E. Sawyer, Goldwyn Studios; Sidney P. Solow, Consolidated Film Industries; and Ub Iwerks, Walt Disney Productions. A color film showing the use of automation in the Hughes Aircraft Co. supplemented Mr. Adamson's address.—*John W. DuVall*, Secretary-Treasurer, c/o E. I. du Pont de Nemours & Co., 7051 Santa Monica Blvd., Hollywood 38.

The Dallas-Fort Worth Section met November 27 in the Banquet Room of Chantly's Resturant, Dallas. Nineteen members and guests attended. Jack Frazier, President of International Electronics Corp. gave a demonstration of hi-fidelity sound reproduction from the Frazier-May speaker. Phillip Wygant, TV Production

Supervisor of Station WBAP-TV, Fort Worth, gave an address on color TV lighting.—*R. K. Keitz*, Secretary-Treasurer, 7123 Westbrook Lane, Dallas.

New Members

The following members have been added to the Society's rolls since those last published. The designations of grades are the same as those used in the 1956 MEMBERSHIP DIRECTORY.

Active (M) Associate (A) Student (S)

This is the fifth list of New Members supplementing the April Journal, Part II, Directory.

Albright, Robert Frank, Medical Photog., Eli Lilly Lab. for Clinical Research. Mail: 2343 N. Webster Ave., Indianapolis 19, Ind. (A)

Bell, Howard R., Vice-Pres. Sales, Mole Richardson Co., 937 N. Sycamore, Hollywood 38. (M)

Berzins, Vallis, Asst. Cameraman, Herbert Kerkow, Inc. Mail: 24 Timber Rd., Glen Cove, N.Y. (A)

Birns, Jack, Co-Owner, Birns & Sawyer Photo Supplies, 8910 Santa Monica Blvd., Los Angeles 46. (A)

Booth, Walter W., Jr., TV Techn., WPIX-TV. Mail: 201 E. 39 St., New York. (A)

Bratton, Orley John, TV Supvr., USAF. Mail: Box 308, Edwards, Calif. (A)

Brown, Frank Albert, Techn. Supvr., Colorvision, Inc., 6061 W. Third St., Los Angeles. (M)

Burleyson, Garth, Mot-Pic Recordist, Capital Film Labs. Mail: 8207 17 Pl., Aldelphi, W. Hyattsville, Md. (A)

Buss, John P., Film Techn., General Film Labs. Mail: 11663 Oxnard St., N. Hollywood. (A)

Byer, Maxwell Theodore, Techn. Dir., Byer Industries Pty. Ltd., 8 Dorcas St., S. Melbourne, Vict., Australia. (M)

Canter, Edward Harrison, Recording, Sound. Technisonic Studios, 1201 Brentwood, St. Louis 17, Mo. (A)

Carroll, Thomas Joseph, Production Manager, Lewis & Martin Films, Inc. Mail: 7421 Coles Ave., Chicago 49. (A)

Cartwright, Vern William, Photog., Free-Lance. 1048 Toneight Way, Sacramento, Calif. (M)

Chang, Kuo-Sin, Mot-Pic Producer, The Asia Pictures Ltd., 203 Princess Theatre Bldg., Kowloon, Hong Kong, China. (M)

Chao, Eugene Yao-Chun, Recording Eng., U. S. Information Service, 187 Electric Rd., First Fl., Hong Kong, China. (M)

Chow, Raymond Ting-Hsing, Radio & Mot-Pic Productions, U. S. Information Service. Mail: 459 Sect. 4 Homuntin New Village, Kowloon, Hong Kong, China. (M)

Cooper, Peter H., Production Mgr., U.P.A. Pictures, Inc., 60 E. 56 St., New York. (A)

Corcoran, Laurence M., Studio Owner, Servicio Espanoles De Sonido S.A., Claudio Coello 124, Madrid, Spain. (M)

Crane, Richard Warren, Supervisor of Color Operations, CBS. Mail: 5 Hawthorne La., Valley Stream, N.Y. (A)

Craney, Ed B., Radio & TV, Net. Mail: Box 1956, Butte, Mont. (A)

Curwen, Ernest Charles, Supvr. Application Eng. Lab., Sylvania Electric Products, Inc. Mail: Box 21, S. San Gabriel, Calif. (M)

Davidson, James R., Photog., Free-Lance, 4708 Wedgewood, Bellaire, Tex. (M)

Dean, Curtis, Product Designer, Fairchild Camera & Instrument Corp. Mail: 99-05 63 Dr., Rego Park 74, N.Y. (M)

Denham, Elmer Chester, Mot-Pic Lab. Techn., Cine-Graphic Film Lab., Inc., 1720 Olive St., St. Louis 3, Mo. (A)

Dudley, Winfield Harold, Supvr. Projection & Sound, Stanley Warner Theatres, 6425 Hollywood Blvd., Hollywood. (A)

Easson, Alexander, Photog. Instrumentation Engineer, Computing Devices of Canada, Ltd., 4 Lake Ave., Carleton Pl., Ont., Can. (M)

Elliott, Joe Wilson, Photog.-Cameraman, Free-Lance, 612 N. Rossmore Ave., Hollywood 4. (A)

Emmerson, George, Supvr. Photog., Jet Propulsion Lab. Mail: 3012 Henrietta Ave., La Crescenta, Calif. (A)

Ferrucci, Jack R., Univ. S. Calif. Mail: 1569 Glenville Dr., Los Angeles 35. (S)

Finestauri, Elio, Director of Lab., Stabilimento S.P.E.S., Viale Campo Boario 57, Rome, Italy. (A)

Florea, John, Cameraman, Free-Lance, 1080 Ravoli Dr., Pacific Palisades, Calif. (M)

Fornoles, Juan D., Chem. Eng., LVN Pictures, Inc., Quezon City, P.I. (A)

Foshaug, Martin Melvin, Mot-Pic Producer, Jet Propulsion Lab., 254 Fillmore St. Pasadena Calif. (A)

Fracker, Henry Edward, Sound Eng., Westrex Sound Services, Inc., 1021 N. Seward St., Hollywood 38. (M)

Gabourie, Fred W., Chem. Eng., Motion Picture Enterprise, Inc. Mail: 367 W. Spazier Ave., Burbank, Calif. (M)

Gallez, Douglas Warren, Univ. S. Calif. Mail: 4617 Adenmoor Ave., Lakewood 8, Calif. (S)

Gaynor, Wardell, Cameraman, UPA Pictures, Inc. Mail: 23 Hillside Ave., Newark, N.J. (A)

Gips, Robert E., Vice Pres. Production, Mel Gold Productions, Inc., 1639 Broadway, New York 19. (M)

Goldsmith, Walter D., Magnetic Recording Applications Eng., Ampex Corp., 934 Charter St., Redwood City, Calif. (M)

Gorth, Philipp Wayne, Film Timer, Consolidated Film Industries. Mail: 11832 Dalwood Ave., Norwalk, Calif. (A)

Gundelach, Charles A., Cameraman-Production, Free-Lance, 2311 Brewster Ave., Redwood City, Calif. (M)

Hanson, Everett Lyle, Foreman, General Film Labs. Mail: 2242 Camden Ave., Los Angeles 64. (A)

Hart, Hal, Title Maker, Free-Lance, 4077 Beverly Blvd., Los Angeles 4. (A)

Heath, Donald Stevens, Univ. S. Calif. Mail: Aeneas Hall, Los Angeles 7. (S)

Henry, Jon, Univ. Calif. L.A. Mail: 3914 Berry Dr., Studio City, Calif. (S)

Ho, George Hoo-Chong, Senior Executive, Manners Engineering Ltd., Box 235, Alexandra House, Hong Kong, China. (A)

Hoadley, Howard W., Manager, Mot-Pic & Still Depts., Marquardt Aircraft Co. Mail: 9143 Petit Ave., Sepulveda, Calif. (A)

Hodgkins, Roger W., Radio & TV Eng., Guy Gannett Broadcasting Services. Mail: RFD 2, S. Portland, Me. (M)

Hoffmann, Howard E., SRT TV Studios. Mail: 3169 Waterbury Ave., New York. (S)

Holcomb, Arthur Lee, Associate Dir. Research, Deafness Research Lab., 4570 Sunset Blvd., Los Angeles 27, (M)

Hu, King Chin-Chuan, Radio Program Prod., U. S. Information Service, 46B Kadoorie Ave., Kowloon, Hong Kong, China. (M)

Irish, George H., Mot-Pic Sound Recordist, U. S. Government. Mail: 2725 Ordway St., N.W., Washington 8, D.C. (M)

Kalet, Donald, Chemist, Ace Film Labs. Mail: 1845 Ocean Ave., Brooklyn 30, N.Y. (A)

Kanamura, Riichi, Chief Eng. Sound Recording Equip., Daiei Mot-Pic Kabushiki Kaisha. Mail: Oogino-Machi, Hanazono, Ukyo-Ku, Kyoto, Japan. (A)

Kay, Joseph E., Tech. Operations Supvr., National Broadcasting Co., Sunset & Vine, Hollywood. (A)

Kell, Ray D., TV Eng., RCA Labs., 487 Jefferson Rd., Princeton, N.J. (M)

Kellogg, George S., Instrument Designer, Free-Lance, 2607 Evans Dr., Silver Spring, Md. (M)

Kirkham, Robert Joseph, Lab. Technician, U. S. Government. Mail: 2212 Woodberry St., Hyattsville, Md. (M)

Kuperman, Howard, Film Editor, UPA Pictures, Inc. Mail: 35 W. Eighth St., New York. (A)

Kushner, Lawrence D., Photog., Rand Corp. Mail: 605 S. Barrington, W. Los Angeles 49. (A)

Laughridge, Tom Ovander, Mot-Pic Cameraman, Lockheed Aircraft Corp., 1732 N. Wilton Pl., Hollywood 28. (A)

Leung, Mathew P. W., Radio Techn., U.S. Information Service. Mail: 10 Junction Rd., First Fl., Kowloon, Hong Kong, China. (M)

Long, Fang, Manufacturer, Taiwan Film Studio, 14 S. Chungking Rd. Second Sect., Taipei, Taiwan, China. (M)

Lynch, Harold M., Cinematographer, Technisonic Studios, Inc., 1714 Canary Cove, Brentwood 17, Mo. (A)

Maurer, Leon Herbert, Tech. Dir., Illustrated Films, Inc., 8460 Santa Monica Blvd., Hollywood 46. (M)

Maurer, Norman Albert, Producer, Illustrated Films, Inc., 8460 Santa Monica Blvd., Hollywood 46, (A)

Mayer, Bruce, Lab. Techn., Charter Oak Telepictures, 846 Seventh Ave., New York. (A)

McWilson, Roger C., Elect. Eng., General Electric Co. Mail: 257 Granvil Dr., Louisville 18, Ky. (A)

Menville, Douglas Alver, Univ. So. Calif. Mail: 3016 Shrine Pl., Los Angeles 7. (S)

Miller, Charles H., Photographer, Timer, USAF, 4780 Burkhardt Ave., Dayton 3, Ohio. (A)

Miller, Henry L., Radio & Mot-Pic Officer, U.S. Information Service, Hong Kong, China. (M)

Miltenburg, William Hubert, Chief Eng. & Mgr. Recording Dept., Radio Corp. of America, Victor Div., 155 E. 24 St., New York 10. (M)

Mitchell, Stanley John, Jr., Lab. Techn., Capital Film Labs., Inc. Mail: 518 Ninth St., N.E., Apt. 310, Washington 2, D.C. (M)

Miyamoto, Hirotsugu, Eng. Sound Equipment, Westrex Co. Mail: 40, 3 chome Morita-cho Nakamuraku, Nagoya, Japan. (A)

Mulholland, George C., Sound Eng., Canadian Film Industries, Ltd. Mail: F11 Kingscourt Apts., Ajax, Ont., Can. (A)

Nam, Lee Mong, Tech. Mgr. Film Studio, Malay Film Productions, Ltd., 8 & 9 Jalan Ampas, Singapore, Malaya. (A)

Neroda, Emil, Sound Eng., Reeves Sound Studios. Mail: 1526 Brookside Dr., Union, N.J. (M)

Niklewski, Martin Stanley, Mot-Pic Lab. Techn., U.S. Government. Mail: 1307 Twelfth St., N.W., Apt. 402, Washington 5, D.C. (M)

Odze, Meyer, City Coll. N.Y. Mail: 1765 Bathgate Ave., Bronx 57, N.Y. (S)

Pan, Sunny S. T., Correspondent, Pan-Asia Newspaper Alliance, Printing House, 6 Duddell St., Hong Kong, China. (M)

Pfister, Robert Arthur, Chem. Eng., Cinerama, Inc. Mail: 86 Baldwin Ave., Baldwin, N.Y. (A)

Propper, Philip, Administrative Asst., Todd AO Corp. Mail: 605 E. 82 St., New York. (A)

Read, Keith E., Eng., Cinesound Co., & KCOP. Mail: 4103 Sea View Dr., Los Angeles 65. (A)
Roeth, Harold W., Antioch Coll. Mail: 209 Xenia Ave., Yellow Springs, Ohio (S)
Scott, Walter K., 3601 Wisconsin Ave., Washington, D.C. (A)
Sharpe, Donald Sidney, Film Inspector, Peerless Film Processing Corp., 35 Christopher St., New York. (A)
Shaw, Vee-ing, Company Dir. & Mgr., Shaw & Sons Ltd., 18 Dorset Crescent, Kowloon-Tong, Hong Kong, China. (M)
Shiomi, Bunsaku, Chief Eng. Sound Recording Equip., Nikkatsu Cinema Studio, 400, 4 chome Hyakunin-Cho Shinjuku, Tokyo, Japan. (A)
Skot-Hansen, Mogens, Producer, Pres., Laterna Film, 10 Sct. Jorgens Alle, Copenhagen V, Denmark. (M)
Snazelle, Ernest Edward, TV Film Producer, Free-Lance, 315 Sutter St., San Francisco, (M)
Sterling, D. L., Mot-Pic Editor, Northrop Aircraft. Mail: 1258 W. Vernon Ave., Los Angeles 37. (A)
Stratton, Charles Nelson, Mot-Pic Cameraman, Panavision, Inc. Mail: 1024 Via Mirabel, Box 903, Palos Verdes Estates, Calif. (A)
Terry, Leon Ronald, Eng., Canadian Broadcasting Corp., Box 10, Snowdon, Montreal, P.Q., Canada. (M)
Terry, John J., Sales Eng., Bell & Howell Co., 7100 McCormick Rd., Chicago 45. (A)
Tong, Siu-Kee, Eng., Westrex Co., Asia, 401 Victory House, Wyndham St., Hong Kong, China. (M)
Vides, Max Mejia, Cameraman & Editor, Cinefoto Massi & Co. Mail: Juan Mora 57, Col. C. R., San Salvador, C.A. (M)
Wilson, Oscar Cecil, Mgr., Canadian Broadcasting Corp. Mail: 225 Indian Rd., Toronto, Ont., Can. (M)
Wilson, Paul M., Lab. Techn., Eastman Kodak Co. Mail: 2625 Purdue St., Los Angeles 64. (A)
Wilson, Stanley S., Supvr. Video Operations, Canadian Broadcasting Corp., 4539 Wilson Ave., Montreal, P.Q., Can. (M)
Wyper, William Worthington, Mot-Pic Dept., North American Aviation, Inc. Mail: 3845 Gardenia Ave., Long Beach 7, Calif. (A)
Yaeger, Renee J., Assistant Lab. Mgr., Western Cine Service. Mail: 3124 W. 20 Ave., Denver, Colo. (A)
Yeh, Li, Managing Dir., Central Motion Picture Corp., 150 Poh Ai Rd., Taipei, Taiwan, China. (M)
Zaccaro, Neil, Broadcast Eng., WKNB, 104 N. King St., Elmont, N. Y. (A)
Zugerman, Milton, Plant Manager, Color Research Labs., 321 S. 12 St., Philadelphia 7. (M)

CHANGES IN GRADE

Bayless, Hugh, (S) to (A)
Fleischer, Eugene B. (S) to (A)
Gold, Leon Sigmund, (S) to (A)
LeGault, Joseph William, (S) to (M)
Mankofsky, Isidore, (S) to (A)
Moore, Russell Gordon, (A) to (M)
Morrison, James C., (S) to (A)
Muir, Duane Manson, (S) to (A)
Neumer, Jr., Arthur E., (A) to (M)
O'Rork, William M., (S) to (M)
Stockert, Henry A., (S) to (A)

DECEASED

George Burgess

Flat 6, 72 Notting Hill Gate, London W. 11, England. (A)

books reviewed

Color Television Engineering

By John W. Wentworth, Published (1955) by McGraw-Hill Book Co., Inc., 330 West 42 St., New York 36. 459 pp. Illus. Graphs. 6 × 9 in. Price $8.00.

This book has been prepared for engineers who are familiar with basic television principles and circuits: deflection, synchronization, clipping, d-c restoration, etc. The material is based on lecture notes over the period 1950–1955, which fact has no doubt contributed to the orderly arrangement, freedom from errors, and noteworthy clarity.

Part 1 is an excellent presentation of the physical and psychological aspects of color, and the measurement and specification of color.

Part 2, Principles of Color Reproduction, includes useful background material on photographic color methods, and a very comprehensive discussion of transfer characteristics.

Part 3, Principles of Color Television Transmission Systems, contains some details of color transmission on the standard 6-mc television channel, and the makeup of the NTSC color signal. Multiplexing techniques used in the NTSC system are described, and consideration is given to the field, line, and dot sequential systems. Historical information is held to a minimum consistent with clear explanation of the broad concepts. This section might have been expanded, and in parts would have been strengthened by more specific design detail.

Part 4, dealing with Apparatus and Circuits for color television; is the book's only major weakness. The author, by and large, emphasizes as "typical" the methods and equipment of but a single manufacturer, and minimizes contributions to the art by others. On page 326, relative to flying-spot scanners, it is stated ". . . several companies announced commercial models of color television cameras based on this approach." As a matter of fact, there are three companies that have commercial units of this type available for sale; and there are a number of color film scanner installations, the first of which was put into regular broadcast service in October 1954. Color slide scanners were in regular use before this. Live color scanners, admittedly a more recent application (demonstrated before NARTB in 1955) are not mentioned. Similarly, certain types of display tubes and test equipment which have been described in the literature are not discussed. This section may have limited usefulness to an engineer desiring to obtain complete information on available equipment and circuitry.

The schematics and illustrations are clear; the index is properly detailed, and the references are relatively complete up to January 1954. Of interest to this reviewer was Fig. 7-7, which may inadvertently show some of the difficulties inherent in the color printing process. The test wedges were checked by 22 persons picked at random, and in every case the observed resolution of the color wedges was at least twice that indicated for the "typical observer."

On the whole, Mr. Wentworth's book is extremely well done. It is a valuable contribution to the literature and is recommended for all who are concerned with color television.—*R. D. Chipp*, Director of Engineering, Allen B. Du Mont Laboratories, Inc., 35 Market St., East Paterson, N.J.

Television and Radar Encyclopaedia, 2d ed.

Edited by W. MacLanachan. Published (1954) by Pitman Publishing Corp., 2 West 45 St. New York 36. 216 pp. Illus.; graphs. $5\frac{1}{4} \times 8\frac{1}{2}$ in. Price $6.00

The editor and his contributors have endeavored to compile, within the compact space of 216 pp., a volume fitting its title. It is amazing that they have done well, though not perfectly, at this task.

It seems to this reviewer that the volume is at its best where the subjects discussed are covered at some length. For example, the section covering the history of television in Britain is well done and quite informative to American readers. So is the article on Central Control Rooms, that on Aerial (Radar) and that on Outside Broadcast. There is a good appendix, including miscellaneous information such as details of BBC television transmitters and a comparison table of world TV standards.

The faults of the book reside mostly in the shorter definitions which it contains. Some of these are misleading — for example, frequency divider in television is "used principally in the frame time base circuit in which the series of eight frame synchronizing pulses are reduced to one by the coupling from the sync separator circuit." Fortunately this definition concludes with the words "See Integrator"! Also, the wording is not always clear. In the section on electron camera we are told that it has "a grid consisting of a one-ended cylinder with an aperture in the closed end." To one who is pedantic about his semantics, this is a very difficult piece to make! A final example, doubtful in respect of both semantics and science, is the definition of convex lens as "a lens which causes rays of light to be separated and converge to a point on a plane at the focal length of the lens, on the side remote from the object viewed." The book would be much improved by the omission of many of these shorter definitions.

Since the book is published in England, there is a natural tendency to emphasize British terminology. There has been some attempt to include American definitions, not always necessary since many of the

terms are used on both sides of the Atlantic. Some unusual terms such as "Earthy" (referring to the bypassed end of a tube load circuit) and "Heart shape reception — see Cardioid Diagram" were new to your reviewer — perhaps they are to be regarded as England's answer to some quaint American technical terms, such as "parc" and "bootstrap"!

As a short technical reference in the fields of television and radar, the book has much to recommend it. It must therefore be forgiven for its shortcomings, in the hope that, if its authors agree with these criticisms, they may be corrected in a later edition.—*F. J. Bingley*, Philco Corp., Tioga and C Sts., Philadelphia 34.

Transistors I, RCA Laboratories.

Published (1956) by RCA Laboratories, N.J. 676 pp. Illus. 6 × 9 in. Price $4.50.

Transistors I is a collection of 41 papers by 39 authors on various aspects of the transistor. These papers are the result of research and development work at the RCA Laboratories; ten of them have been published previously. The papers cover a wide range of transistor technology and are divided into six sections: General, Materials and Techniques, Devices, Fluctuation Noise, Text and Measurement Equipment, and Applications. Abstracts of 46 additional papers resulting from RCA transistor studies are appended. It should be emphasized that *Transistors I* is not an elementary text on transistors; it is a collection of useful reference papers on the subject.

The introductory or general section of the book contains two review papers. The first covers physical concepts of the transistor, and the second describes some state-of-the-art transistors, a few circuit applications, and some additional physical concepts. Both of these articles are interesting reading for those not already familiar with semiconductor devices.

The Materials and Techniques section includes three articles on innovations in germanium crystal processing, and six articles related to fabrication techniques in transistors. The paper on "Microscopic Examination of Germanium Crystals and Transistors" is a particularly interesting and thorough treatment of the topic. Generally, the Materials and Techniques section will be of most interest to semiconductor device engineers, and some of the techniques described will be well known to them. However, many engineers interested in circuit applications of the transistor would find this section useful in broadening their knowledge and understanding of the transistor.

The Devices section describes the design, construction and performance of new germanium and silicon devices. The first two papers concern improved emitter efficiency at high currents and improved germanium power transistors. The third paper describes a silicon alloy junction transistor. The fourth paper describes the design of a transistor with equal input and output impedances for use in direct coupled iterative circuits. The fifth and sixth papers discuss improved high-frequency transistors, while the seventh and last paper of the section covers a germanium junction diode with voltage-variable capacitance for use in UHF circuits. Most of the devices described in this section are experimental and not available as production items. While semiconductor devices engineers will find the Devices section well worth reading, it has less value to the circuit engineer.

Three papers comprise the Fluctuation Noise section. The first paper discusses in detail the noise power — inverse frequency relation, or 1/f noise in diodes and transistors. Two other papers cover noise representation and measurements in junction transistors. The effect of d-c bias on noise is shown.

The test and Measurement Equipment section provides detailed information on high-frequency transistor test equipment, and on testing transistors for power output applications. This section will be very useful to device engineers or circuit engineers who are responsible for transistor testing, and will be of general interest to many others.

Almost half of *Transistors I* is devoted to the circuit Applications section. The first applications paper is a review of ambient temperature effects on transistor operation. Several bias stabilizing circuits are shown. The next five papers discuss the use of transistors in IF and RF circuits and include papers on an experimental automobile receiver and a developmental pocket size broadcast receiver. The next three papers cover power and audio amplifiers, including complete circuit and performance details of a 20-w transistor audio amplifier. The audio amplifiers are followed by a paper on amplitude and frequency modu-

lation of transistor oscillators. Then there are three papers on transistorized television receiver circuits, including sync separator, vertical deflection and AFC circuits. Finally, there are three papers on transistor switching and counting circuits. The Applications section provides many practical ideas about transistor circuitry, and gives the performance evaluation of a number of experimental circuits. This section should be very useful and interesting to circuit engineers.

Following the Applications section there are 46 abstracts of papers resulting from RCA transistor work which were not included elsewhere in the volume. These abstracted papers also cover a wide range of transistor technology from solid state physics to transistor circuit applications.

Transistors I contains reference material valuable to all phases of transistor work, and it should be considered a worthwhile addition to an engineer's transistor library. The book is not definitive on all the subjects covered, but it does present a large quantity of otherwise unpublished material available within RCA. While the book does not teach basic transistor electronics, it has extensive supplemental value to those who have an introductory knowledge of transistors.—*W. V. Wright, Jr.*, Pacific Semiconductors, Inc., Culver City, Calif.

Transistors Handbook

By W. D. Bevitt. Published (1956) by Prentice-Hall, Inc., 70 Fifth Ave., New York 11. 410 pp. Illus. 8½ × 6 in. Price $9.00

Transistors Handbook deals with the practical aspect of transistors and transistor circuits. The first eleven of twenty-one chapters describe transistor characteristics, measurement techniques and circuit analysis. The last ten chapters are devoted to various kinds of transistor circuit applications and are largely comprised of specific circuits. The book does not dwell on physical concepts or detailed circuit analyses of the transistor.

The chapter headings give an account of the material covered: introduction, fundamental definitions and concepts, point contact transistors, junction transistors, power transistors, measurement of transistor characteristics, methods of analysis of transistors and transistor circuits, tetrode and pentode transistors, photodiodes and phototransistors, some practical considerations in transistor circuits, noise and temperature effects in transistors, transistor audio and power amplifiers, transistor R-F amplifiers, audio oscillators, R-F oscillators, amplitude modulation and detection, frequency modulation and detection, transistor radio and television receivers, relaxation oscillators, computer applications, and miscellaneous applications. The appendix contains definitions of semiconductor terms (IRE Standards, 1954), transistor manufacturers and transistor characteristics.

There are two limitations to the usefulness of *Transistors Handbook*. First, almost all of the material and references compiled in the book are dated 1953 or earlier. Many transistors and transistor circuits representative of current practice have been developed since 1953; in fact, maturation of the transistor industry really started in the period 1954–6. Neither transistors themselves nor transistor circuits are "standardized" yet, and there will be many useful innovations in transistors and circuits developed during the next several years. Secondly, the very practical approach used in *Transistors Handbook* which leans heavily on examples of early circuits (pre-1954) does not give the basic design steps of building a transistor circuit. The circuit engineer will not find much assistance in solving a current circuit design problem.

While it is probably too early in the rapidly growing transistor electronics field to accumulate enough accepted and standardized information for a true handbook, this book should be of considerable use to many experimenters, technicians, electronic servicemen, radio amateurs, etc. The transistor circuit engineer will be better served by current texts and reference articles on transistors and transistor circuits.—*W. V. Wright, Jr.*, Pacific Semiconductors, Inc., Culver City, Calif.

Die Kinematographische Kamera

By Dr.-Ing. Harald Weise. *In German.* Published as Vol. III of a series entitled *Die Wissenschaftliche und Angewandte Photographie*. Edited by Dr. Kurt Michel of Aalen/Wuerttemberg, by the Springer Verlag, Moelkerbastei 5, Vienna 1, Austria, 1955. 472 pp. 6¾ × 9¾ in. 521 illus., schematic diagrams and photographs. Available in the U.S. through Stechert-Hafner, Inc., 31 East 10 St., New York 3. Price $20.00.

As indicated in the editor's preface of the volume, the above work is part of a series to replace and bring up to date the well-known *Handbuch der Wissenschaftlichen und Angewandten Photographie* by A. Hay and M. von Rohr. The intent was to supersede this almost classic work with a multi-volume, encyclopedic reference series, each volume of which would be a self-contained fragment of the art, thus overcoming the deficiencies of an all-encompassing single handbook which can be up-dated only by the unsatisfactory practice of issuing periodic supplements. The present volume is in the best tradition of its predecessors, combining technical accuracy and painstaking attention to detail with thorough coverage of recent developments, including high-speed photography.

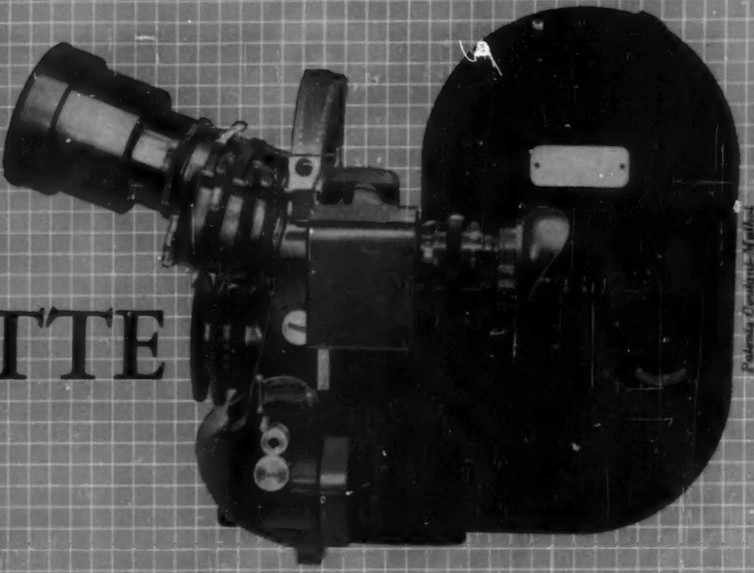
Dr.-Ing. Harald Weise is the author, among other works, of *Kino Geraete Technik* which has previously been reviewed in the November 1951 *Journal*). He has thus been able to draw on an extensive experience in the precision mechanism field in general, and photographic apparatus in particular. *Die Kinematographische Kamera* includes some of the excellent illustrations of the earlier work, while intentionally presenting the present state of the art of camera construction from a more descriptive than an analytical viewpoint. The extent of the coverage of European and American equipment is quite astonishing when one considers that in many cases the author cannot have had much more information at his disposal than the sketchy sales literature of the manufacturers. This observation held true for *Kino Geraete Technik*, and holds true now. In support of this consideration, the reader's attention is called to a bibliography of 736 items from U.S., French and German sources.

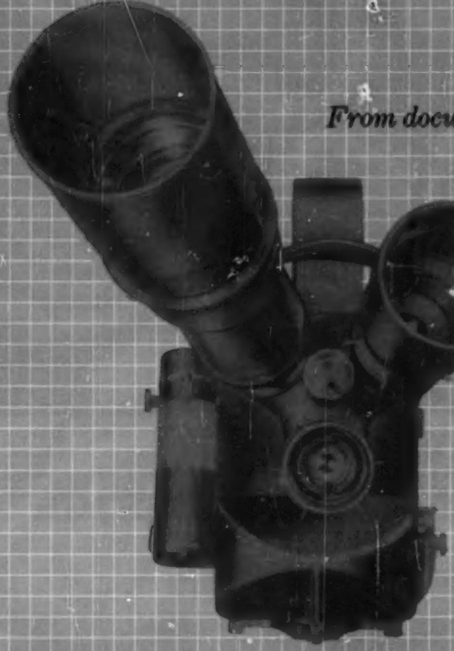
An effort has been made to present the construction details of such mechanisms as film drives, intermittent movements, shutters, governors, optical systems, finders, rangefinders, and coupled diaphragms in an easily understandable and systematic manner. To this end, families of devices related by common operating principles have been grouped, and certain historical trends in the evolution of these devices demonstrated. At the same time, the author avoided the pitfall of letting the presentation degenerate into a mere cataloging of museum pieces. The work is so profusely illustrated that, in the opinion of the writer, little or no knowledge of German would be required for the designer and engineer to use it as a thesaurus of camera mechanism. Though not explicitly stated, it is to be presumed that the bulk of the ideas diagrammed belong to the public domain, so that, in most cases, the problem of patent infringement would not exist. However, common caution in this regard should not be ruled out.

Besides photographs and pictorial diagrams, the book contains analyses of cycles kinematic and force diagrams, acceleration graphs and equations, making it necessary often to adapt only certain parameters and physical dimensions to the designers' specific problems, in order to obtain neat solutions to what otherwise might be tough nuts to crack. This is not to say that the know-how of precision mechanism can not be found with as great detail and often with far more profound mathematical treatment, in many texts of engineering mechanics and kinematics. Rather, we have here a selected concentration of those mechanisms apt to be encountered in camera design, and an impressive parade of the way in which many men and many manufacturers have solved problems which seem to have a nasty habit of recurring each time we set out to design a new piece of camera equipment.

Among other things, the book covers such topics as parallax characteristics of viewfinders, blurring due to image motion and its parameters, constructional details of a representative number of objective lenses, registration errors, et al. It has always seemed regrettable to the writer that there appear to be so few educational courses in this country, where a young man might train to become a photographic engineer and camera designer. Certainly the importance of photographic instrumentation to science and industry, to say nothing of the military establishment, would justify such a specialty. And yet the predominant part of the requisite skills must still be picked up on an on-the-job apprenticeship basis in the engineering departments of the companies in the field. Perhaps an increase in the number of good reference texts such as the present one, both here as well as abroad, would help in providing a much-needed impetus to the further propagation of the photographic art.—*Peter V. Norden*, IBM Research Laboratories, Poughkeepsie, N.Y.

CAMERETTE





From documentary to data recording . . .

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Camerette, world's most versatile motion picture system, with factory designed accessories that adapt the camera in seconds to virtually every photographic need. Attachments shown convert it quickly and easily to accomplish: Documentary • Data Recording • Missile Tracking • Air to Air • Time Lapse • X-Ray Cinematography • Microphotography • Instrumentation Analysis

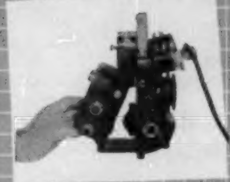
Available as 35 mm or 16/35 mm combination. Lenses of all leading manufacturers available.

Accepted and approved by major film studios, by military departments, defense industries and by independent film producers, both here and abroad.

Factory engineered accessories eliminate expensive redesign or modification of camera. Each is simply and readily adaptable to Camerette for converted uses. Send for descriptive literature.

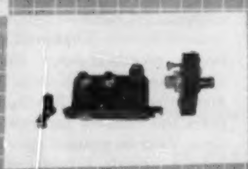
Control box and pip (indexing) light.

Regulation control box for operation in instrumentation recording.



Instrumentation contactor attaches to standard camera body. Houses either counter or chronometer.

Insertion of 16 mm aperture—a 10-second conversion from 16 mm to 35 mm with appropriate magazine.



Phase control for step motion motor. Contactor. Counter (left). Chronometer (right).

Intervalometer for stop and go. Interval remote control for pre-determined cycling from ½ sec. to 3 mins.

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11809 WEST OLYMPIC BOULEVARD, LOS ANGELES 64, CALIFORNIA
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Employment opportunities:
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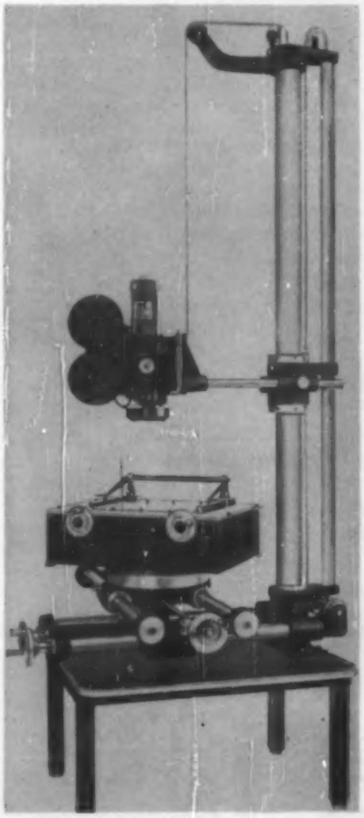
new products

(and developments)

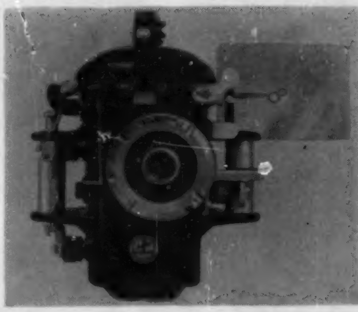
Further information about these items can be obtained direct from the addresses given. As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of these items does not constitute endorsement of the products or services.



The Tel-Animastand, a new low-cost animation stand that permits the production of cartoons, titles and other special effects, has been announced by S.O.S. Cinema Supply Corp., 6331 Hollywood Blvd., Hollywood 28. A movable counter-balanced vertical carriage which photographs the artwork is designed to support the heaviest of 16mm or 35mm cameras. Standard components and interchangeable parts increase the flexibility of the unit. The Add-A-Unit or "building block" idea was adopted so that the basic animation stand may have other equipment added to it.

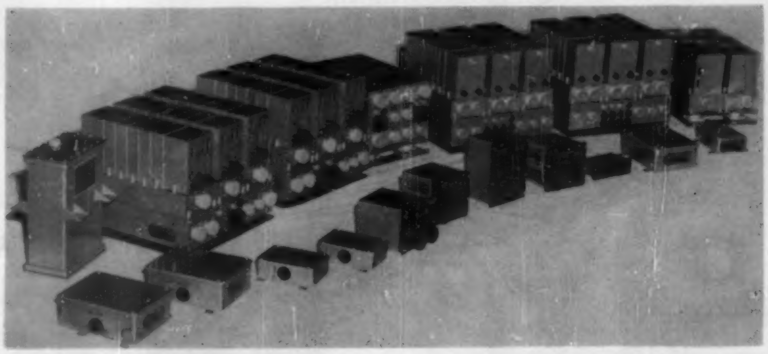
Optical effects such as pans, angles, zooms or quick close-ups are accomplished by raising or lowering the camera. The compound table can turn a full 360° as well as travel to the front, back or either side. All basic movements associated with animation stands now used by the industry are incorporated. Further information may be obtained from the company at its Hollywood branch or from the New York headquarters at 602 W. 52 St., New York 19.

The Strong Super Trouper, a product of the Strong Electric Corp., 87 City Park Ave., Toledo 2, Ohio, is a high-intensity arc spotlight with a self-contained power supply unit consisting of a transformer and selenium rectifier. It draws 10 amp from a 230-v single-phase line supply, or can also be supplied for 110-v, 20-amp operation. It is reported to equal or exceed in brilliancy of spot many large theater-type spotlights operating at a much higher amperage. The length of the spotlight house is 80 in., the base diameter is 28 in., and the vertical tilt pivot is adjustable between 52 and 65 in. from the floor. The equipment, with a net weight of 395 lb, is mounted on casters and is designed for ease of disassembling into two units for shipment. Shipping weight is 625 lb.

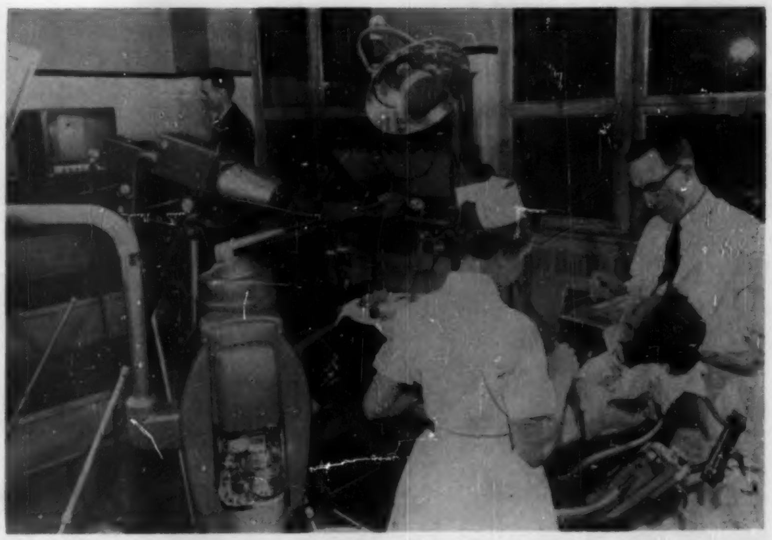


The Bolex Underwater Case for photographic equipment used by skin divers is designed for use at depths down to 330 ft. It is designed to hold any Bolex H-16 camera locked into place with one lever, without the use of tools or alterations of the camera body. It is calibrated for any Kern Paillard wide-angle lens — Switar 10mm *f*/1.6; Switar 16mm *f*/1.8; Yvar 16mm *f*/2.8. The equipment is designed to be operated from the outside while under water with all essential controls provided for — including winding, diaphragm setting and shutter release. The footage counter is visible from the outside. Viewing is done through a parallax-corrected gunsight located on the side of the case. Priced at $600.00, it is available from Paillard Products, Inc., 100 6th Ave., New York 13.

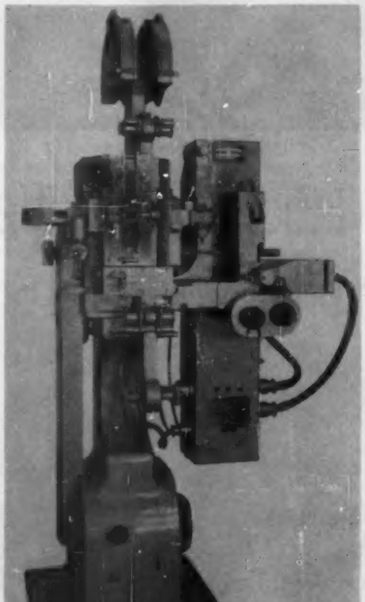
Hanimex (U.S.A.) Inc., distributors for Durst copy cameras and color enlargers, AK-16 motion-picture cameras and the Siemens 2000 16mm projectors, has opened a branch office at 770 11th Ave., New York. The company's main office is at 90 Stevenson St., San Francisco. Operating as Hanimex (Pty) Ltd., the company maintains offices at Sydney, Australia, Auckland, N.Z., and a recently opened branch at Tokyo, Japan.



The Universal Camera Control System is a simplified, light-weight, electronic camera control system developed especially for airborne reconnaissance but applicable to other uses. The Bill Jack Scientific Instrument Co., Solana Beach, Calif., manufactures this entirely automatic system. Input data, such as ground speed, altitude above terrain, terrain brightness, camera depression angle, lens focal length and film sensitivity are fed to the system which computes its answers continuously and rapidly by DC analog methods. It operates for all types of aerial cameras, computing data on how fast to move the film to equal the velocity of the image, how much light to let through the lens, how long to expose the film and how often to take a picture so that succeeding photographs will overlap uniformly. The building block system permits replacement of each plug-in package with an improved or miniaturized unit as soon as it is developed.



A closed-circuit system using an RCA ITV-6 TV chain with a Perkin-Elmer Auto-Zoom Lens enables students at the University of Pennsylvania's School of Dentistry to peer, along with the instructor, into the patient's mouth. The instructor speaks into a microphone hung around his neck, which leaves his hands free for handling drills and other dental tools. The Auto-Zoom Lens permits the students to see the relative positions of patient, dentist and equipment as well as close-up views of the patient's teeth.



Matipo-Color Model C.C. 1956, is the latest model film printer announced by Andre Debrie Manufacturing Corp., 39 W. 32 St., New York 1. The machine was designed especially to meet the requirements of color and of large screens. It is presented in four models, C.C.35; C.C.16; C.S.35; and C.S.16. The first two models are especially designed for pre-print materials, monochrome separation positives, superimposed internegatives and reversal masters. The C.S. models are designed for production printing. Brochures and mounted examples of work on these printers are available to show the printing and operating characteristics, products and accessory equipment.

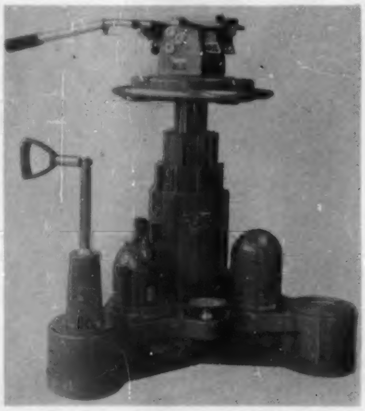
The new Guardian Exposure Meter is shown including the attachment of the Dynacell, an external cell which, when added, is reported to increase the meter's sensitivity by 4 times for reflected light and by 64 times for incident light. The General Electric Company's Guardian Meter has been announced as designed to be twice as sensitive as the firm's older PR-1 exposure meter. The new meter is reported to give a useful reading with light so poor that with film rated at ASA 100, an exposure of one full second would be required with a diaphragm opening of $f/5.6$. Details are available from General Electric dealers about adjustments and adaptability of this direct-reading meter for high and low light values, motion pictures, the Exposure Value System and Polaroid uses. The new meter costs $34.50; the Dynacell light cell, an additional $7.95; and the incident-light attachment, $1.50.

The Super-Farron $f/0.87$ Lens has been announced by the Farrand Optical Co., Bronx Blvd. and E. 238 St., New York 70, as a well-corrected, high-speed objective designed to assure effective results in photographic and television applications even under the most unfavorable lighting conditions. It is reported to cover a wide field (30°) with a correction that holds up over a broad spectrum.

In a 76mm focal length, the Super-Farron covers a 40mm diameter field, and is suitable as an objective for use with the image-orthicon in TV cameras and for 35mm photography. In addition to the standard infinity correction for direct photography, the lens can be supplied corrected for 16:1 magnification for fluoroscopic application and corrected for 4:1 magnification for photography of oscilloscopes. It can be supplied for TV with correction for the envelope thickness of the pickup tube. Further technical and detailed information can be found in Engineering Report No. 327 available upon request from the company.

The Neumade Shepard Electronic Film Splicer has been announced by Neumade Products Corp., 250 West 57th St., New York 19. Exhibited at the SMPTE Convention at Los Angeles, it is the result of research to develop a method for splicing not only older film stocks but also "Cronar," newly developed by E. I. du Pont de Nemours & Co. Cronar cannot be satisfactorily joined by the conventional splicing methods. The new splicer has been designed for CinemaScope and standard film perforations. The splicing is described as done electronically, using dielectric heating to bond the ends. The splices are made without cement or solution of any kind. An overlap of 0.03 in. is produced.

Secret Work Handled by Ansco Motion Picture Processing Laboratories: An ambiguity in an article in the September *Journal* (p. 531) has been called to our attention. The article stated that High-speed Anscochrome 16mm motion-picture film is now being sold without the cost of processing included in the price of the film, the reason being that government and industrial users engaged in confidential work would be enabled to maintain full security by handling processing through their own or selected laboratories. This is correct. The article then states that for non-confidential work Ansco maintains its two processing laboratories at 2299 Vaux Hall Road, Union, N.J. and 247–259 E. Ontario St., Chicago, from which an inference may be made that the laboratories do not handle confidential or higher classified work. This is incorrect. Confidential films are processed in the Ansco Motion Picture Processing Laboratories and the Union, N.J., laboratory has security clearance for all material up to and including "Secret."



A studio pedestal dolly designed to meet the special requirements of a TV camera mounting has been announced by W. Vinten Ltd. of London. The equipment can be tracked or crabbed as required by the movement of a foot-controlled lever and is mounted on three sets of double wheels. The central column is supported on triple hydraulic rams compensated by two compressed nitrogen cylinders and a hydraulic accumulator. This system allows prompt head adjustment by lifting or lowering by hand the pedestal head. Foot pedals are provided which lock the central column in any desired position. The three-draw central column permits a height differential of 32 in. and a minimum height of 25 in., measured from the ground to the pedestal head. The maximum height is 57 in. The normal operating weight of the equipment without a pan-and-tilt head is 430 lb. Export inquiries should be addressed to Cinematograph Export Ltd., 715 N. Circular Rd London NW2, England.

The Mole Richardson Co.'s Catalog E lists specialized lighting equipment for motion-picture, still and TV studios. The catalog also contains illumination tables, power distribution data and other information. It can be obtained by writing to the company at 937 N. Sycamore Ave., Hollywood 38.

employment service

These notices are published for the service of the membership and the field. They are inserted three months, at no charge to the member. The Society's address cannot be used for replies.

Positions Wanted

Administrative Engineer. The SMPTE's Staff Engineer, Henry Kogel, is seeking a new position, after 6 years working with SMPTE Engineering Committees and the motion-picture standards program; also serving as Secy, American Standards Assn. Sec. Committee PH22, and Tech. Secy, International Standardization Orgn. Tech. Com. 36, Cinematography; 2 years, previously, develop. engr. with Sperry Gyroscope Co.; B.S. Elec. Eng., Columbia Univ., 1948, after military service as radio off.; age, 37; married; N. Y. area pref.; complete résumé upon request—Henry Kogel, 19–24 202 St., Bayside 60, N. Y.; Tel. BAyside 9-3574, or at SMPTE, LOngacre 5-0172.

Photographic Development Engineer. Freelance or consultation. Long experience in design, development and production engineering of both military and commercial motion-picture and still cameras and projectors, enlargers, film editors, lapsed time and sequence cameras, viewers, automatic aperture controls, stereographic, press cameras, etc. Military and commercial references available on request. Write: P.O. Box 601, Jamaica 31, N.Y.

Radio-Television Production or Directing Assistant. January graduate Boston Univ. (B.S. Communication Arts). Experienced AM-FM-TV engineer (First Class Radio-Telephone License). Radio production and directing experience. Desire position with radio or TV station specializing in live programming or with TV film organization. Complete résumé on request. Louis Maggi, 110 Lonsdale St., Dorchester 24, Mass.

Sound Recordist-Mixer-Editor. 18 years experience as broadcast and recording studio technician, including $2\frac{1}{2}$ years variable area sound film, double system. Moviola editing and cutting. Formal musical education, read long score. Transmission systems design, maintenance and installation. Past 5 years as Technical Director and Production Assistant for network package producer with own facilities. Duties included multiple tape re-recording and editing with responsibility for selection of b.g. music and effects. Administrative. Highly specialized in "trick" audio, producing over 1100 of these shows for ABC-Radio. Some camera experience, own Cine Special. Detailed résumé on request. 38 years old, married, stable. Wm. Mahoney, 69 Tokeneke Rd., Darien, Conn.

Positions Available

Television Film Director. Major department head with proven record of administrative, technical and leadership ability sought by WPIX, New York, to supervise all film operations at station. Man with outstanding qualifications will be offered salary in five figures. Write full details to: L. J. Pope, WPIX, Inc., 220 East 42d St., New York.

Top Sales Engineer for projection carbons. Nationwide or territorial. Must have extensive experience in the field and good contacts. Write: Suite 3403, 70 Pine St., New York 5.

Professional Services

THE INDEX TO THIS VOLUME HAS BEEN REMOVED FROM THIS POSITION AND PLACED AT THE BEGINNING OF THE FILM FOR THE CONVENIENCE OF READERS

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News Columns

Advertisers

Meeting Calendar

Symposium on Communication Theory and Antenna Design, sponsored by Air Force Cambridge Research Center and Boston University, Jan. 9–11, 1957, Boston University, Boston, Mass.
3rd National Symposium on Reliability and Quality Control in Electronics, Jan. 14–16, 1957, Hotel Statler, Washington, D. C.
American Institute of Electrical Engineers, Winter General Meeting, Jan. 21–25, 1957, Hotel Statler, New York.
Audio Engineering Society, West Coast Convention, Feb. 7, 8, 1957, Ambassador Hotel, Los Angeles.
National Photographic Show, Feb. 16–24, 1957, New York Coliseum, New York.
Optical Society of America, Mar. 7–9, 1957, Statler Hotel, New York.
Radio Engineering Show and IRE National Convention, Mar. 18–21, 1957, New York Coliseum, New York.
American Physical Society, Mar. 21–23, 1957, U. of Pennsylvania, Philadelphia, Pa.
International Photographic Exposition, Mar. 22–31, 1957, National Guard Armory, Washington, D. C.
American Chemical Society, Apr. 7–12, 1957, Miami, Fla.
National Academy of Sciences, Apr. 22–24, 1957, Washington, D. C.
Symposium on the Role of Solid State Phenomena in Electric Circuits, Polytechnic Institute of Brooklyn, Apr. 23–25, 1957, Engineering Societies Building, New York.
American Physical Society, Apr. 25–27, 1957, Washington, D. C.
American Society for Testing Materials, June 16–21, 1957, Chalfonte-Haddon Hall, Atlantic City, N. J.
American Institute of Electrical Engineers, Summer General Meeting, June 24–28, 1957, Montreal, Que.
81st Semiannual Convention of the SMPTE, including Equipment Exhibit, Apr. 29–May 3, 1957, Shoreham Hotel, Washington, D. C.
Western Electronic Show and Convention, Aug. 20–23, 1957, Cow Palace, San Francisco
82nd Semiannual Convention of the SMPTE, including Equipment Exhibit, Oct. 4–9, 1957, Philadelphia-Sheraton, Philadelphia.
83rd Semiannual Convention of the SMPTE, including Equipment Exhibit, April 21–26, 1958, Ambassador Hotel, Los Angeles.
84th Semiannual Convention of the SMPTE, Oct. 20–24, 1958, Sheraton-Cadillac, Detroit.
85th Semiannual Convention of the SMPTE, including International Equipment Exhibit, May 4–8, 1959, Fontainebleau, Miami Beach.
86th Semiannual Convention of the SMPTE, including Equipment Exhibit, Oct. 6–10, 1959, Statler, New York.

SMPTE Officers and Committees: The rosters of the Officers of the Society, its Sections Subsections and Chapters, and of the Committee Chairmen and Members were published in the April 1956 Journal.

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National Cine Equipment, Inc.
National Screen Service Corporation
National Theaters Amusement Co., Inc.
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